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ADVANCED SUBSYSTEMS STATUS MONITOR.(U)  
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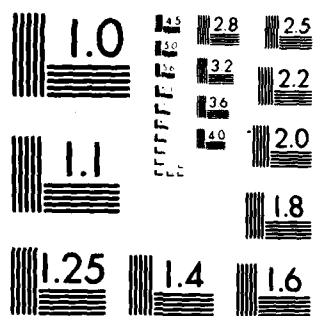
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## APPLIED TECHNOLOGY LABORATORY POSITION STATEMENT

This report addresses a promising approach for reducing pilot workload in Army helicopter cockpits. The approach advocates combining the multitude of presently used subsystem instruments and annunciator displays into two multifunctional flat-panel cockpit indicators. It is believed that this work effort represents a first-time attempt to apply multifunction display technology and human factors engineering techniques to the problems of man-machine communication and pilot workload associated with monitoring the status of helicopter subsystems. The results of this effort are being exploited by the U. S. Army Avionics Research and Development Activity, Fort Monmouth, New Jersey, as part of the Electronic Master Monitor and Advisory Display System (EMMADS) development.

The technical monitor for this effort was Mr. Joseph D. Dickinson, Applied Aeronautics Technical Area, Aeronautical Systems Division, Applied Technology Laboratory.

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br>Five tasks were completed toward the design of an advanced Subsystem Status Monitor that will reduce crew workload during the monitoring of helicopter subsystems:<br>(1) Analysis of parameters currently monitored in the UH-60A, CH-47C, OH-58C, and AH-1G Army helicopters, and recommendation of information requirements for these helicopters, |   |   |  |

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(2) Development of prioritization, logic, and display formats for the presentation of subsystem information on multi-function electronic displays for the above-mentioned helicopters,

(3) Preliminary design of system architectures incorporating state-of-the-art, near-term and long-term technologies into an advanced Subsystem Status Monitor,

(4) Evaluation of preliminary designs to determine predicted impacts on flight safety, workload, reliability and maintainability, survivability and vulnerability, aircraft space and volume, aircraft weight, and life cycle costs,

(5) Design of keyboard and associated display formats for the following peripheral functions: checklist presentation, performance calculation, and load monitoring.

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## INTRODUCTION

All-weather/night/nap-of-the-earth helicopter flight has dramatized the importance of reducing crew workload as a high priority effort toward improving mission effectiveness.

The past and predicted growth in the number and complexity of subsystems in U.S. Army helicopters has made subsystem monitoring a prime candidate for design efforts aimed at the reduction of crew workload.

The effort reported herein was directed toward the reduction of crew workload during the monitoring of subsystems in U.S. Army helicopters involved the application of Human Factors engineering principles and U.S. Army pilot recommendations to the design of an advanced Subsystem Status Monitor (SSM).

Five tasks were completed toward the design of an advanced Subsystem Status Monitor that will reduce crew workload during the monitoring of helicopter subsystems:

1. Analysis of parameters currently monitored in the UH-60A, CH-47C, OH-58C, and AH-1G helicopters, and recommendation of information requirements for these helicopters.
2. Development of prioritization, logic, and display formats for the presentation of subsystem information on multi-function electronic displays for the above-mentioned helicopters.
3. Preliminary design of system architecture incorporating state-of-the-art, near-term and long-term technologies into an advanced Subsystem Status Monitor.
4. Evaluation of preliminary designs to determine predicted impacts on flight safety, workload, reliability and maintainability, survivability and vulnerability, aircraft space and volume, aircraft weight, and life cycle costs.
5. Design of keyboard and associated display formats for the following peripheral functions: checklist presentation, performance calculation, and load monitoring.

## TASK I: IDENTIFICATION AND ANALYSIS OF PARAMETERS

Task I included the following efforts:

1. Identification of subsystem parameters currently monitored and displayed in four Army helicopters representative of the following types: utility, cargo, attack, and observation.
2. Cross-comparison of parameters monitored and displayed by each of the helicopters investigated.
3. Identification of subsystem monitoring information requirements for each helicopter investigated.
4. Investigation of the desirability of modifying information requirements for changing mission phases, including: pre-/post-start, takeoff, cruise, hover, land, and pre-/post-shutdown; and for changing environmental conditions, including: night/day, visual meteorological conditions/ instrument meteorological conditions, and nap-of-the-earth/ flight at altitude.
5. Assessment of current and near-term efforts to improve signal source technology and identification of signal source improvements likely to coincide with development of an advanced Subsystem Status Monitor (SSM).
6. Discussion of information requirements with military flight crews rated in relevant helicopter classes during working sessions at Ft. Rucker, Alabama, and incorporation of flight crew inputs into the definition of information requirements.

### IDENTIFICATION OF PARAMETERS CURRENTLY MONITORED AND DISPLAYED IN REPRESENTATIVE ARMY HELICOPTERS

Operators Manuals were consulted for the following Army helicopters: UH-60A (utility), CH-47C (cargo), OH-58C (observation), and AH-1G (attack). The following information was tabulated for each helicopter: subsystem parameters displayed, range of each parameter, normal (green zone) operation band for each parameter, precaution (amber zone) limits for each parameter, malfunction (red zone) limits for each parameter, indicator type displaying each parameter, signal source for each parameter, and type of signal source output (parameter type). This data was summarized for each helicopter, and is presented in Tables 1 through 8 in Appendix A.

The UH-60A and the CH-47C are twin engine helicopters, while the OH-58C and the AH-1G are single engine helicopters, and parameter listings in Tables 1 through 8 reflect this distinction. The AH-1G is a tandem helicopter, with separate instrument and caution panels for pilot and gunner. Tables 7 and 8 therefore include an additional column indicating whether the given parameter is displayed to pilot, gunner, or both.

### CROSS-COMPARISON OF PARAMETERS

Parameters displayed in the UH-60A, CH-47C, OH-58C, and AH-1G were cross-compared. Tables 9 through 12 in Appendix A summarize these cross-comparisons.

Table 9, which itemizes parameters displayed in all four helicopters, is noteworthy by virtue of its brevity. The parameters itemized in Tables 10 through 12, however, should not be categorized as superfluous, since many of these parameters are representative of subsystems peculiar to specific aircraft.

#### IDENTIFICATION OF SUBSYSTEM MONITORING INFORMATION REQUIREMENTS

A composite list of all parameters displayed by any of the four helicopters investigated was prepared. The composite list was reviewed for each helicopter independently, and the following requirements were identified:

1. Priority of the given parameter information for the given helicopter, classified as follows:

A. Safety: The information is essential for the maintenance of aircraft and crew safety.

B. Mission: The information is not safety-essential, but is essential for mission fulfillment.

C. Maintenance: The information is neither safety- nor mission-essential, but is necessary for post-flight maintenance recommendations.

D. Unnecessary: The information is not safety-, mission-, nor maintenance-essential.

2. Mission phases during which it is necessary to display the given information, including takeoff, cruise, hover, landing, and shutdown.

3. Mission environments during which it is necessary to display the given information, including: night, day, visual meteorological conditions (VMC), instrument meteorological conditions (IMC), nap-of-the-earth flight (NOE), and flight at altitude.

4. Essential but not superfluous display logic, classifying parameters as:

A. Continual: The information should be displayed continually and automatically.

B. Critical only: The information should be displayed automatically only when it represents exceedance of critical limits.

C. Access only: The information should not be automatically displayed under any conditions, but manually accessed display provisions should exist.

5. Essential but not superfluous display format, classifying display requirements as:

A. Quantitative: Digital readout is essential and sufficient.

B. Qualitative: Analog representation is essential and sufficient.

C. Combined: Combined digital readout and analog representation is required.

D. Caution: Caution message without digital readout or analog representation is essential and sufficient.

E. Advisory: Advisory message without digital readout or analog representation is essential and sufficient.

The results of this information requirements analysis are presented in Tables 13 through 16 in Appendix A.

Tables 13 through 16 represent the finalized information requirements resulting from baseline information requirements defined by Sikorsky Human Factors engineers; information requirements analysis by U.S. Army helicopter pilots at Ft. Rucker, Alabama, and flight test pilots at Sikorsky Aircraft; and analysis of the feasibility of incorporating mission phase-specific and environmental condition-specific display logic into the eventual SSM design. The baseline information requirements suggested by human factors engineers are presented in Tables 17 through 20 in Appendix A. Tables 17 through 20 anticipate the format of an information requirements questionnaire that was later submitted to Army pilots at Ft. Rucker and to test pilots at Sikorsky Aircraft, and represent the first step toward the finalized identification of information requirements presented in Tables 13 through 16. The other phases toward finalizing information requirements are described below.

#### DISCUSSION OF INFORMATION REQUIREMENTS AND DISPLAY LOGIC WITH U.S. ARMY HELICOPTER PILOTS AND SIKORSKY AIRCRAFT TEST PILOTS

A questionnaire soliciting responses to questions concerning information requirements and display-by-exception logic and formats was prepared and presented to 45 Army pilots rated in the CH-47C, OH-58C, and UH-1H helicopters at Ft. Rucker, Alabama. The same questionnaire was presented to Sikorsky Aircraft test pilots with UH-60A experience.

Questionnaire administration was preceded by briefings explaining SSM design goals, display-by-exception philosophy, and instructions, and was succeeded by in-depth follow-up interviews during a one-week visit by human factors engineers and Army contract monitoring and electronics specialists, as well as Army human factors specialists.

A complete sample questionnaire is presented in Appendix B.

The questionnaires were analyzed to form a composite response set for each aircraft. These composite results are presented in Tables 21 through 24 in Appendix B.

#### INVESTIGATION OF THE DESIRABILITY OF MODIFYING INFORMATION REQUIREMENTS FOR CHANGING MISSION PHASES AND ENVIRONMENTAL CONDITIONS

The subsystem monitoring information currently displayed in the UH-60A, CH-47C, OH-58C, and AH-1G was compiled into a single list of parameters monitored and displayed, by any of the four helicopters. For each parameter displayed, the mission phases during which the parameter is currently relevant were identified for each helicopter. In addition, for each helicopter displaying a given parameter, the type of indicator currently used to display the parameter was identified.

Table 25 in Appendix A presents a Parameter X Helicopter X Mission Phase cross-comparison for each parameter currently displayed. In addition, parameters listed in Table 25 are grouped by subsystem.

Table 25 complements Tables 1 through 8, which list parameters currently displayed in the four helicopters, and Tables 9 through 12, which cross-compare helicopters, by: allowing direct comparison for each parameter of helicopters displaying or not displaying the given parameter, allowing direct comparison for each parameter of the types of indicator currently used to display the given parameter, and grouping all parameters

into subsystems.

Taken together, Tables 1 through 16 and Table 25 suggest that: there is currently a lack of standardization across helicopters of the parameters that are monitored and displayed, even where no helicopter-peculiar requirements exist (engine fire, engine oil quantity, XMSN oil temperature, hydraulic pressure, and electrical power are examples); and while there is general agreement across helicopter types in terms of the indicator type employed in displaying commonly displayed parameters, there are noticeable differences, including vertical scale versus dial instruments, warning versus caution lights, and audio tone auxiliary warnings.

Table 25 does not present recommended information requirements, but rather analyzes the mission-phase relevance of currently displayed parameters. The analytical results presented indicate that with the exception of the APU subsystem, mission-phase distinctions between information requirements are minimal. Where the APU is activated for in-flight use, mission-phase distinctions are further minimized.

In addition to the factor of minimal distinctions between mission-phase information requirements, the following factors argue against designing a separate monitoring/display logic for different mission phases: there is no easily sensed parameter that can be relied upon to govern automatic mode switching by mission phase; and manual mode switching during transitions between mission phases would increase crew workload (manipulation, planning, memory, and decision-making), particularly during single-pilot operation.

Organization of information requirements differentially for differing environmental conditions was also deemed of limited value because: environmental conditions are subject to sudden and frequent fluctuations which cannot be sensed automatically; the requirement to respond to frequently fluctuating environmental conditions by manual mode selection would increase crew workload, especially during single-pilot operation; and information requirements do not differ significantly for differing environmental conditions.

The goal governing the design of the advanced SSM was to reduce crew workload during the monitoring of helicopter subsystems. Throughout the design process, the flexibility of computerized monitors and electronic display devices was therefore consciously bounded by the requirement that the SSM not increase the crew workload by requiring additional manipulation, taxing human memory and information-processing capacity, or delaying response time by complicating decision-making processes. In the cases of mission phase-specific and environmental condition-specific information requirements, an exercise of technological flexibility would negatively impact crew workload, due to the minimal distinctions present.

The major factor governing the stringent requirement for reduced workload is the all-weather/night/NOE flight profile. Rather than attempt to account for this profile as a distinct helicopter mission with peculiar requirements, the all-weather/night/NOE profile was taken as a worst-case workload problem whose solution would transfer automatically to reduced workload under all other situations.

Where only dedicated indicators are permitted, crew workload reduction efforts are limited to the design and placement of individual

indicators and the identification of information requirements that suggest the addition or removal of indicators. Where multi-function displays are permitted, however, the effort to reduce crew workload is not limited to identification of information requirements, but rather emphasizes the importance of defining the logic governing the nondedicated display of subsystem information. On this account, Task II (Definition of Information Handling Formats) is viewed as the major effort toward crew workload reduction, and Task I is viewed as a preliminary phase during which human factors engineers and Army pilots defined the information to be displayed and established mutually agreeable principles governing display-by-exception logic for helicopter subsystems.

The information presented in Tables 1 through 25, therefore, must be viewed as merely preliminary to Task II Army pilot reviews and definition by both human factors engineers and Army pilots of display logic and formats.

#### ASSESSMENT OF SIGNAL SOURCE TECHNOLOGY

Table 26 lists the major types of signal source devices employed in the four helicopters studied for which avenues of improvement have been identified. Figures included are approximate. The majority of improvement avenues listed consist of improved accuracy and reliability without resort to radical design changes. Additionally, however, the following points resulted from assessment of signal source technology:

1. Currently, the major avenue of radical signal source design change appears to be fiber-optics technology, which is being employed experimentally in tachometers and heat sensors.

2. The only signal source reliability/accuracy/repeatability problems consistently identified by interviewed Army pilots were chip detectors, engine fire detectors, and low fuel detectors.

3. An advanced SSM which includes provisions for sensor failure analysis (through computerized modelling and/or cross-comparison of triply redundant sensors) can effectively inhibit the display of false warnings independently of improved signal source technology per se. The preliminary designs identified in Task III contribute toward this end.

## TASK II: DEFINITION OF INFORMATION HANDLING FORMATS

Task II involved the definition of information handling logic and display formats for the presentation of the information recommended in Task I.

### DEFINITION OF DISPLAY LOGIC

Tables 27 through 30 in Appendix A summarize the display logic defined for each of the four helicopters studied. The following sections explain the efforts expended to compose Tables 27 through 30.

#### Identification Of Level Of Urgency For Each Parameter

A questionnaire was presented to helicopter instructor pilots at Ft. Rucker, Alabama, and to test pilots at Sikorsky Aircraft. Pilots were asked to classify parameters as safety critical, mission essential, or maintenance required. Pilot classifications were summed for each parameter, and consensus was identified for each parameter. In addition, Technical Manuals were consulted for each helicopter, and where parameters were classified according to the above categories, classifications were itemized. Where pilot consensus was high, this consensus defined parameter categorization. Where pilot consensus was ambiguous, Technical Manual categorizations were applied.

Results of urgency categorization appear in the column labeled URGENCY in Tables 27 through 30. The primary use of this data was to establish a first-level classification of parameters toward later definition of prioritization for all parameters, and for determining warning/caution/advisory classifications of parameter messages.

#### Determination of Desirability of Automatic Responses

This effort involved recommendation of automated response to parameter conditions for those cases in which response is not currently automated. The results are tabulated in the column labeled AUTO RESPONSE in Tables 27 through 30. Both Ft. Rucker and Sikorsky pilots questioned generally adhered to the philosophy that automated response to the parameters listed is not desirable. Exceptions include: automatic fuel balancing to maintain within-limits center of gravity; automatic APU actuation after hydraulic system failure, provided that APU in-flight usage is permissible; automatic XFEED or boost pump actuation in response to low fuel pressure, provided that system leakage can be sensed and diagnosed to prevent further loss of fuel that might result from cross-feeding or pumping fuel through portions of fuel systems containing leaks.

Where automatic responses were recommended, it was further decided whether the crew should or need not be informed of automatic corrective action taken. In the past, where automated corrective response action has been incorporated into an aircraft, the question of whether the crew should be informed of the automated response has been debated on an individual case basis, often with consideration in mind for the instrument panel space required for the conveyance of such information via

a dedicated caution light. In addition, the following general principles should and usually do guide decision-making regarding the appropriateness of such feedback:

1. Where the information in question is necessary for the maintenance of safety of flight, for mission go/no-go decisions, or for recommendation of post-flight maintenance, the information should be displayed.

2. Where the information in question represents a change in status of a system whose previous status was known by the crew, the change of status information should be displayed (e.g., automatic change from direct to XFER fuel feed).

The advanced SSM will include two features which also bear upon the decision to display or refrain from displaying feedback of automated responses:

1. On the overwhelming recommendation of Army pilots interviewed, the SSM will include display of precautionary information which assists the crew in predicting caution or warning conditions. The display of loss of redundancy, which has in the past been debated on an individual parameter basis, would be generally recommended for the SSM as a precautionary advisory.

2. While panel space has been an item of concern in the past, the SSM includes multi-function display screens that allow for a more liberal approach to display of advisory and precautionary information.

The items identified as desirable for automatic response feedback are listed in Tables 27 through 30 under the column headed AUTO FEEDBACK.

#### Specification Of Display/Refrain-from-display Logic

For each parameter, the appropriateness of the following alternatives was determined: display continually; display by exception, without allowing manual access; or display by exception, allowing manual access.

Strictly speaking, Rotor Speed and Power Available were the only parameters recommended for continuous display. Power Available was to be displayed by one instrument combining the status of torque, NG, and TGT. A power cursor on the instrument (see Figure 5) will move to the right if any one of these three basic parameter values increases. When any basic parameter reaches its operating limit, the power cursor will reach the fixed limit line, illuminating an advisory message on the alphanumeric panel.

It was determined through pilot interviews and human factors evaluations that all other parameters should be displayed by exception. That is, dedicated (continual) display of all other subsystem parameters should be replaced by a system logic that automatically displays only parameters that are approaching or have exceeded limits, or that are functionally related to parameters that are approaching or have exceeded limits.

This display-by-exception logic is recommended as a means of presenting essential but not superfluous subsystem data. Its value in terms of workload reduction is viewed as most apparent during high (e.g., NOE) workload environments. It was nonetheless deemed desirable to allow manual access of any parameter, so long as manual access was not relied upon as the sole or primary method of displaying essential subsystem information. This manual access capability complements the automatic

display by exception, enabling a reduction of monitoring workload when flight workload is high, while permitting manual access of additional information when flight workload is low.

The column headed DISPLAY LOGIC in Tables 27 through 30 identifies those messages to be displayed automatically by exception and those items of information which may be manually accessed. Items displayed by exception are subdivided and identified as warning, caution, or precaution conditions/messages. Manually accessible items of information are also identified. It will be noticed that more than one display logic code may be applicable to a single parameter.

In addition, the column headed SYSTEM identifies the system whose related parameters are also displayed in conjunction with the given parameter when the parameter is displayed either automatically or by manual access. Where no system is identified, the parameter is displayed alone when displayed automatically, and is not manually accessible.

Tables 31 through 34 in Appendix A list for each helicopter the parameters that are automatically displayed when any other parameter within the same system is automatically displayed, or that are accessed together when a selected system is manually accessed.

It may be noted in Tables 27 to 30 that while any of the systems may be manually accessed, there is no occasion where the hydraulic or electrical systems will be automatically displayed.

#### Specification Of Sufficient But Nonsuperfluous Dimensions To Be Displayed

In Tables 27 through 30 the column headed DIMENSION lists the dimensions recommended as sufficient but not superfluous for each display logic alternative of each parameter (Warning, Caution, Precaution, Advisory, Manual Access).

In arriving at recommended dimensions, pilots at Ft. Rucker and Sikorsky Aircraft were asked to identify which parameters required only quantitative display, which required only qualitative display (analog), which required only status display (Warning, Caution, Precaution), and which required combined qualitative and quantitative display. The responses were analyzed for consensus and reviewed by human factors engineers.

It was further determined during interviews with pilots that while engine and transmission parameters require both qualitative and quantitative display, quantitative and/or status displays are sufficient for fuel, hydraulic, electrical, and APU displays. Specific display formats were determined later.

#### Suggestion Of Parameter Prioritization For Displays

The multi-function display of information dictated that each item of information that could be displayed be assigned a priority that would govern decisions in cases of simultaneous faults. Three steps were undertaken toward assigning priorities:

1. Parameters were classified into the following levels of urgency: Safety, Mission, and Maintenance.
2. Within each urgency classification, priorities were assigned by classifying each message as Warning, Caution, Precaution, or Advisory.

3. Each parameter was ranked for priority independently of the above classifications and this ranking was applied to the above two levels of prioritization to assign a priority for each item of information to be automatically displayed.

The resulting priority assignments are identified in the column labeled PRIORITIES in Tables 27 through 30. Tables 35 through 38 in Appendix A present prioritized listings of items of information for each helicopter.

Manually accessed information has not been entered into the prioritization, and is coded by an asterisk (\*) in the PRIORITIES column of Tables 27 through 30. Manually accessed information will be assigned highest priority on the SSM display.

#### Suggestion Of Candidate System Events For Automatic Recording

It is recommended that the SSM possess the capability of recording the following information automatically during warning, caution, and precaution conditions for all parameters: time and date for each out-of-tolerance condition; duration of each out-of-tolerance condition; status or quantitative reading, where measureable, for all related (same system) parameters; cumulative frequency of out-of-tolerance conditions since most recent playback. Recommended candidates for automatic recording are listed in Tables 27 through 30 in the column headed AUTO RECORDING.

#### SUGGESTION OF HUMAN SENSORY CHANNELS TO WHICH SSM INFORMATION SHOULD BE ADDRESSED

The proposed design of the SSM addresses warning, caution, precaution, and advisory messages and relevant data through the visual sensory channel. Auxiliary presentation of SSM information through the auditory channel was deemed worthy of inclusion in long-term designs, subject to experimental research and testing, since the following factors support use of voice warning as a mode of alerting and data transmission:

1. The visual channel is heavily loaded during NOE flight.
2. Voice warning may prove more attention-getting than visual warning.
3. Pilots interviewed have favored reconsideration of voice warning.

Voice warning systems have been developed and tested in the past.

Unfavorable results have been due mostly to the following factors:

1. Voice warning systems that involve the use of taped messages have suffered from reliability problems (e.g., tape breakage or stretching) and access time lag, including within-message lag between words or phrases.
2. Provisions for intensity dimming have often not been included.
3. Voice warning has been provided only as a backup system, in some cases as a third or fourth warning backup. As such, it has not generally been tested thoroughly on its own merits, and has frequently been deemed by pilots to be a nuisance, especially where no override capability has been provided.

Current technology has advanced beyond previous tape systems to include production of synthesized voice through a variety of digitized storage strategies. The following questions require experimental testing

before synthesized voice warning can be recommended as a primary system:

1. What are the most effective frequency ranges and speech characteristics (male vs. female, "robot" vs. human, tone of voice, rapidity of speech, etc.) that combine speech intelligibility with distinguishing characteristics that differentiate the voice warning messages from other voice communications?

2. Is human reliability superior under voice warning conditions or under visual warning conditions?

3. Are voice warning data transmission rates fast enough to permit effective response?

4. Can and should voice warning be relied upon to present information beyond alerting and announcing, to include data presentation, emergency procedures presentation, commands, etc.?

5. How is voice warning most effectively integrated with other communications in terms of prioritization, crew interaction, etc.?

6. Can and should voice warning be extended to other functions beside subsystem status monitoring?

7. What design features can maximize the effectiveness of voice warning (e.g., cueing or alerting tone prior to voice message, optimal coding of messages)?

It is recommended that laboratory and flight evaluation of current and future voice warning systems be undertaken. Such evaluations should both evaluate specific technologies and establish generic principles to guide the development of voice warning systems. Evaluative study of voice warning configurations and combined voice/visual configurations should include experimental measurement of performance variables such as error rate, reaction time, and other measures of human reliability and workload.

#### SUGGESTION OF DISPLAY LOCATIONS

Existing subsystem status monitoring is characterized by three separate display locations:

1. A master warning/caution display which consists of warning lights which illuminate to alert that a warning condition is in effect and inform the nature of the condition, and a master caution light which alerts that a caution condition is in effect, without identifying the condition.

2. A caution/advisory panel which serves to identify the parameters that are out of tolerance for caution conditions, without qualitative or quantitative indication of parameter level.

3. Subsystem instruments which provide qualitative and/or quantitative data for specified parameters.

The proposed SSM will include all three of the above functions, but will combine them into two separate displays, which should be located in such a fashion as to optimize crew alerting and permit transmission of visual information with minimal eye or head movement on the part of the crew member who must otherwise attend to the outside world. The two displays consist of a main display screen and a separate caution/warning/precaution (CWP) display. The CWP display will serve the purpose of alerting and identifying warning, caution, and precaution conditions, and

will, for selected parameters, identify the quantitative condition of those parameters. The ideal location for the CWP display is currently approximated by the master warning/master caution lights, and it is recommended that this CWP display be inset into the leading edge of the glare shield directly in front of the pilot and the copilot, a separate display being provided for each.

Additional SSM information (including relevant system data, a record of current out-of-tolerance conditions, all manually accessed information, and display of any peripherally accessed information) should be presented separately on the main screen display, in a location where relevant system data is readily viewable with a minimal amount of eye or head movement within the constraints of available instrument panel space, and within reach of pilot and copilot for operation of controls. It is recommended that a separate main screen display be provided for pilot and for copilot, and that these screens be located in the instrument panel as close to the crew members as possible in the areas left vacant by the removal of the dedicated subsystem instruments replaced by the SSM.

In the OH-58C only one of each display is necessary and should be located equidistant from pilot and copilot. In the AH-1G, a tandem helicopter, separate displays should be provided for gunner and pilot.

Figures 1 through 4 illustrate anticipated changes achieved by installation of the proposed SSM displays for the UH-60A and the OH-58C.

#### SUGGESTION OF DISPLAY FORMATS AND SYMBOLOGY

The development of display formats and symbology was guided by the recommendations in Tables 27 through 30 which specify quantitative vs. qualitative vs. combined display formats. In addition, review of literature on symbology and formats resulted in the following guidelines:

1. Tendencies to abuse the flexibility of electronic display devices by displaying excess information in high density should be avoided in favor of emphasis upon the display of essential but nonsuperfluous information.
2. Quantitative information should be displayed digitally with appropriate scaling incorporated where necessary to prevent digit flicker.
3. Qualitative information should include provisions for indication of movement within zones and for indication of critical limits.
4. Where qualitative and quantitative information is presented together for a given parameter, scale markings may be eliminated and qualitative and quantitative indications kept distinct.
5. Where several system-related parameters are displayed simultaneously, out-of-tolerance parameters should be highlighted.
6. Where analog information for several system-related parameters is displayed, the analog scales should be calibrated to allow for quick-scan comparison of parameters.
7. All formats should be submitted to experimental evaluation before a final hardware/software decision is made.

#### Suggestion Of Mode For Control Reaction Feedback

The SSM should duplicate the logic of existing subsystem status

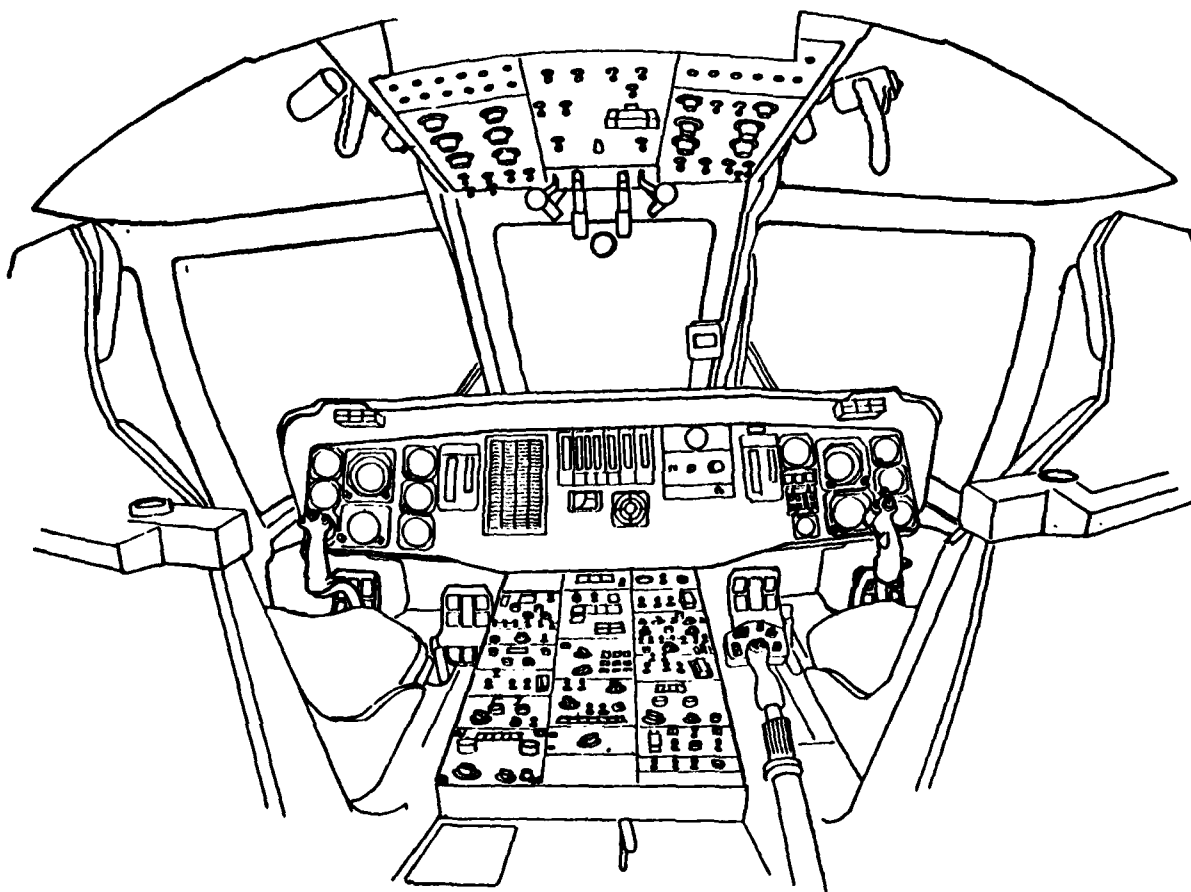


Figure 1. Schematic illustration of the current UH-60A cockpit.

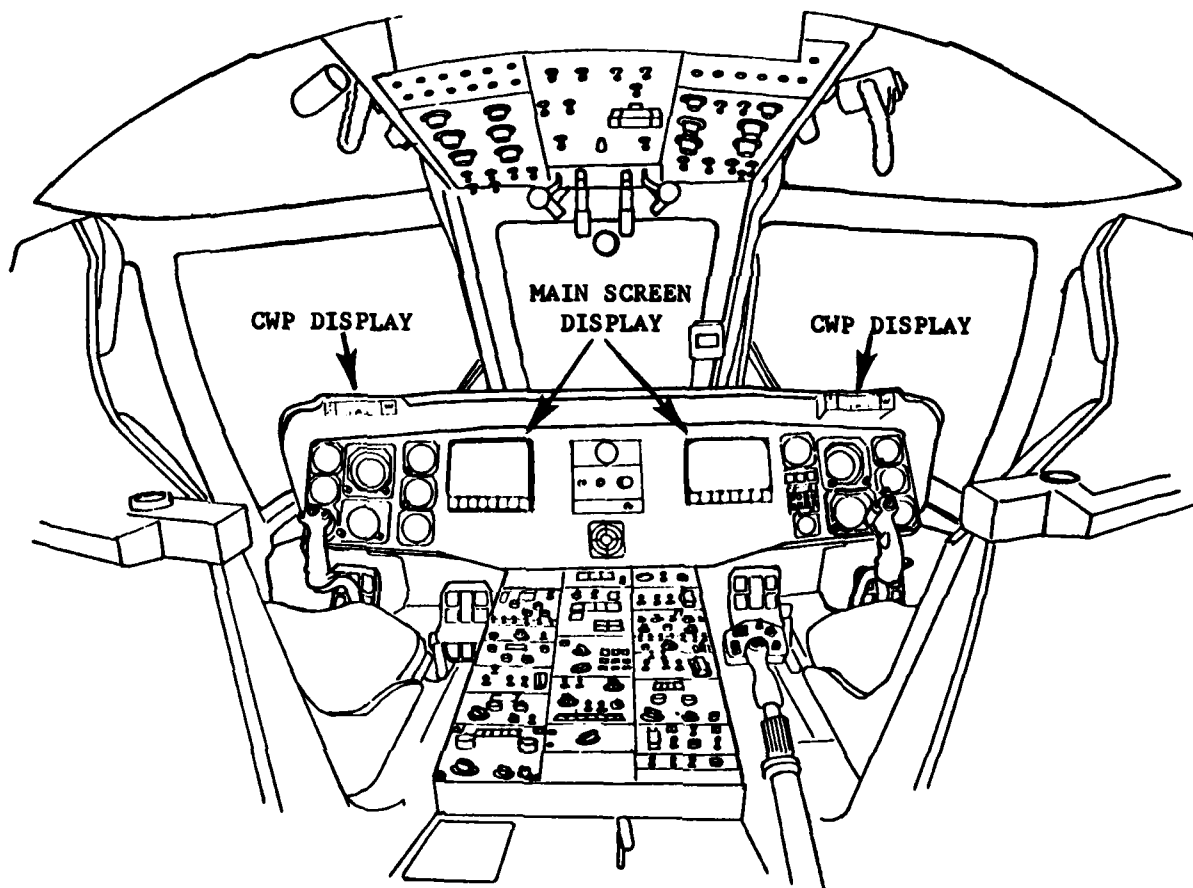


Figure 2. Illustration of SSM installation in the UH-60A.

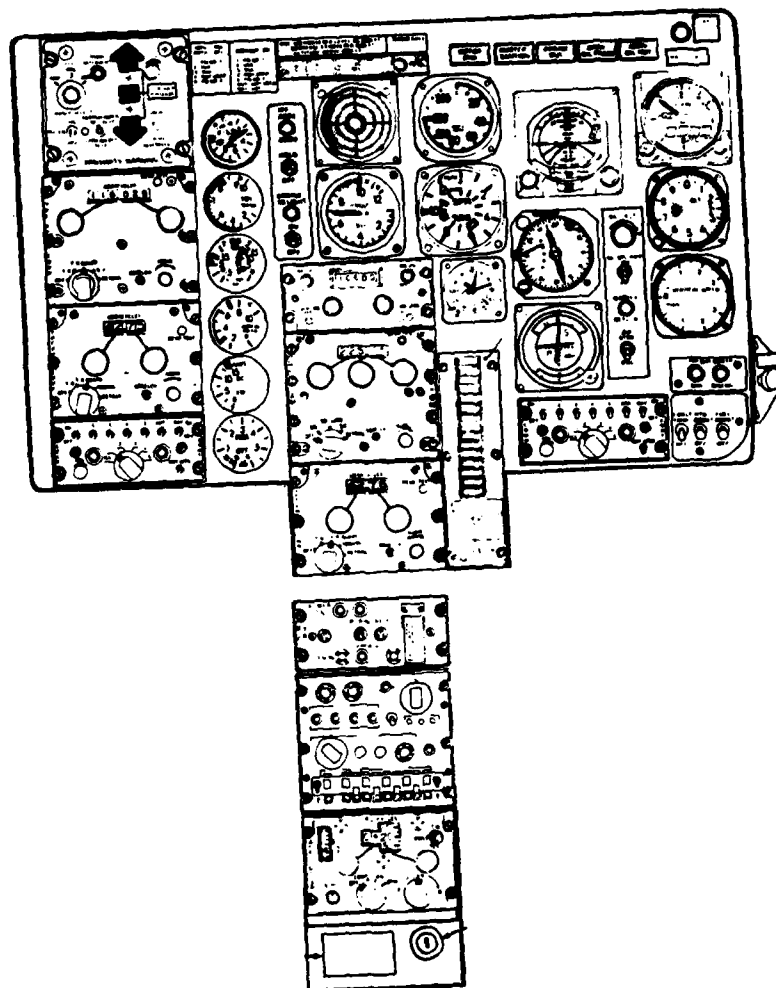


Figure 3. Schematic illustration of the current OH-58C cockpit.

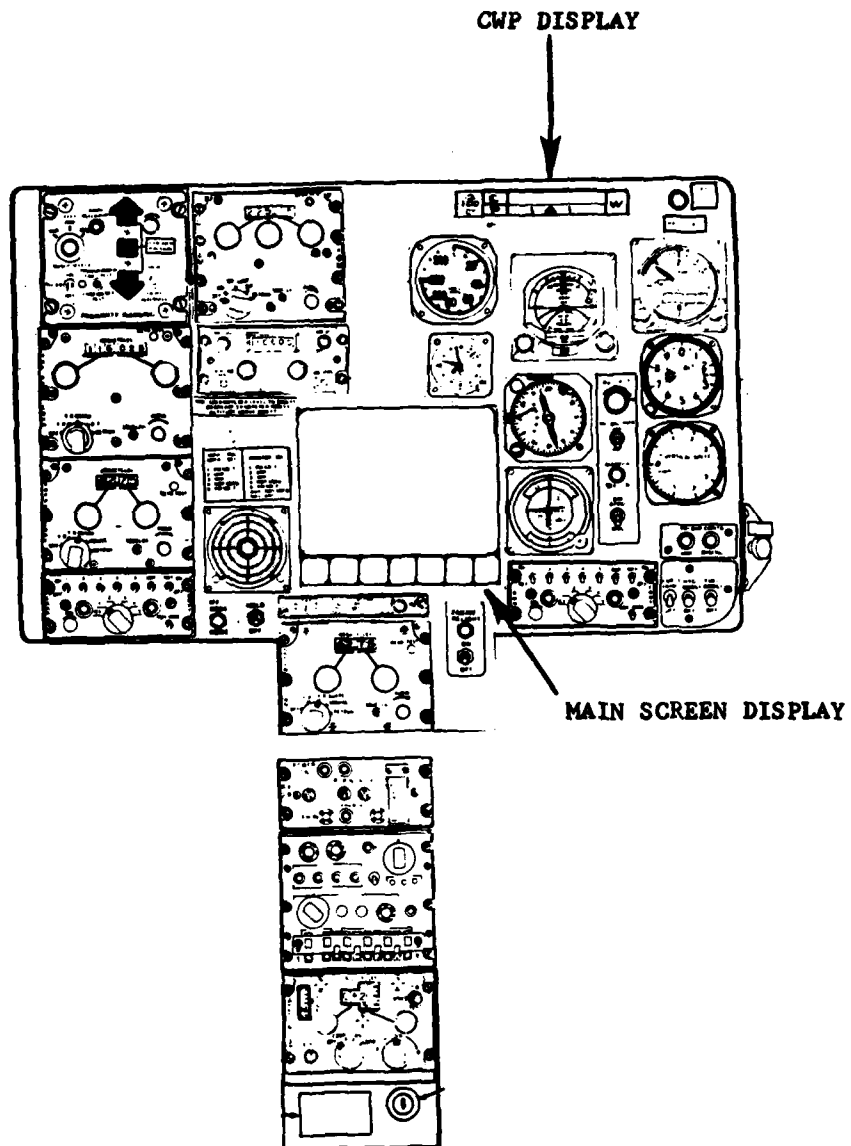


Figure 4. Illustration of SSM installation in the OH-58C.

indicators: corrective response results in the erasure of the caution indication. This logic possesses inherent advantage in that it elevates the SSM to the status of command display. That is, the simplest logic within the environment of high workload NOE flight is a command logic that specifies that the crew need respond only if information appears. An empty screen constitutes feedback that appropriate control reactions have been made. The removal of indications by corrective action reduces the command statements without requiring the crew to monitor excess feedback. Should workload permit, additional feedback, though not required, is attainable through manual access.

#### Design Of Candidate Display Formats

Figures 5 through 18 illustrate the basic display formats. Figures 19 through 32 illustrate display formats through presentation of an hypothesized scenario. Parameters displayed throughout have been taken from the UH-60A, and the emphasis throughout has been upon illustration of display operation and formats rather than upon fidelity of mission scenario.

Figure 5 illustrates the basic display elements. To the traditional master caution and master warning light has been added a master precaution light. While the master caution and master warning lights are triggered by exceedance of preestablished limits, the precaution light is triggered by a combination of exceedance of preestablished precaution limits and a rate of approach to caution limits. Thus, the precaution anticipates caution or warning conditions. All three lights are "press to reset" operated. The warning light flashes red, and the caution and precaution lights flash amber. The small screen located between the caution and warning lights is labeled a Caution/Warning/Precaution (CWP) Display. The CWP is a multi-function display and is ideally collimated for compatibility with night vision goggles, requiring no refocusing of the goggles from out-of-cockpit focus for viewing. Whenever a precaution, caution, or warning condition occurs, the appropriate light illuminates and the appropriate message appears on the CWP display. All such messages are prioritized. In the event of simultaneous out-of-tolerance conditions, the highest priority message is displayed until acknowledged by pressing to reset. Until "bumped" by a new message, the highest priority message will remain on the CWP display. For every parameter listed in Tables 27 through 30 as involving precaution display, the CWP display will include digital indication of parameter status in addition to any precaution or caution message displayed. The horizontal display beneath the CWP display is a Power Management Display (PMD). Its arrowhead cursor moves horizontally, driven by the one of the following parameters which is closest to its limit at any given time: torque, NG, and TGT. The vertical line on the PMD represents the caution limit for the above parameters. Ideally this PMD is also collimated for compatibility with the night vision goggles. To the left of the CWP and PMD is a dedicated Rotor Speed (NR) display, which includes dedicated digital readout of NR and directional arrows that illuminate when a specified rate of increase or decrease in main rotor speed is exceeded, and which indicate direction of change. The arrows are not command displays.

The larger display screen with associated control buttons in Figure 5 is the main SSM display. It is a multi-function display allowing for both automatic and manually accessed display of subsystem information. Whenever a precaution, caution, or warning message appears on the CWP display, the message is also automatically displayed on the main screen, where it remains until the condition is corrected. In the case of fuel, engine, XMSN, and APU parameters, a precaution, caution, or warning message for any individual parameter automatically calls up all related system parameters on the main screen. Advisory messages are displayed automatically on the main display, where they remain until the condition is changed. Related fuel, engine, XMSN, hydraulic, electrical, and APU parameters can be accessed manually by pushing the appropriate dedicated button beneath the main display. All parameters are displayed on the main SSM in prioritized fashion; highest priority parameters appear higher vertically on the screen. System-related parameters are displayed together for fuel, engine, and XMSN systems in the vertical location assigned to the parameter within the system that has been assigned highest priority. Any information manually accessed is granted highest priority and may be erased by a second depression of the access button. Relative positions of parameters displayed as part of a related system (i.e., fuel, engine, XMSN) never change, though the prioritized location of the system itself will change as a function of its highest priority parameter.

Where two displays are provided (one each for pilot and copilot in the UH-60A, CH-47C, and AH-1G), all displays except the precaution, caution, and warning lights function independently. Reset of precaution, caution, and warning lights by one crew member results in automatic reset of the corresponding light for the other crew member. Manual access of subsystem information on the main screen, in contrast, functions independently for pilot and copilot.

#### Review Of Display Logic And Formats With U.S. Army Pilots

The display logic, operation, and formats illustrated in Figures 1 through 32 were reviewed by the same U.S. Army helicopter pilots at Ft. Rucker, Alabama, who had previously provided inputs to the finalized definition of information requirements in Task I. These pilots were generally enthusiastically supportive of the display-by-exception logic and manual access feature. The CWP display was deemed the feature most likely to contribute to reduced workload during NOE flight. Potential contributions of the SSM to increased visibility through reduced instrument panel size were mentioned, and Army personnel recommended that advantage be taken, especially in scout aircraft, of the SSM's replacement of dedicated subsystem instrumentation to improve the overall instrument panel configuration. Decisions to display the highest priority message on the CWP screen, to highlight out-of-tolerance parameters on the SSM main screen, and to emphasize the command philosophy of the SSM (displayed information commands attention and response; blank screens indicate no action to be taken) were firmed through Army pilot interviews. In addition, during one-week follow-up interviews, peripheral functions that could be performed by the SSM were discussed. These peripheral functions are described in Task V.

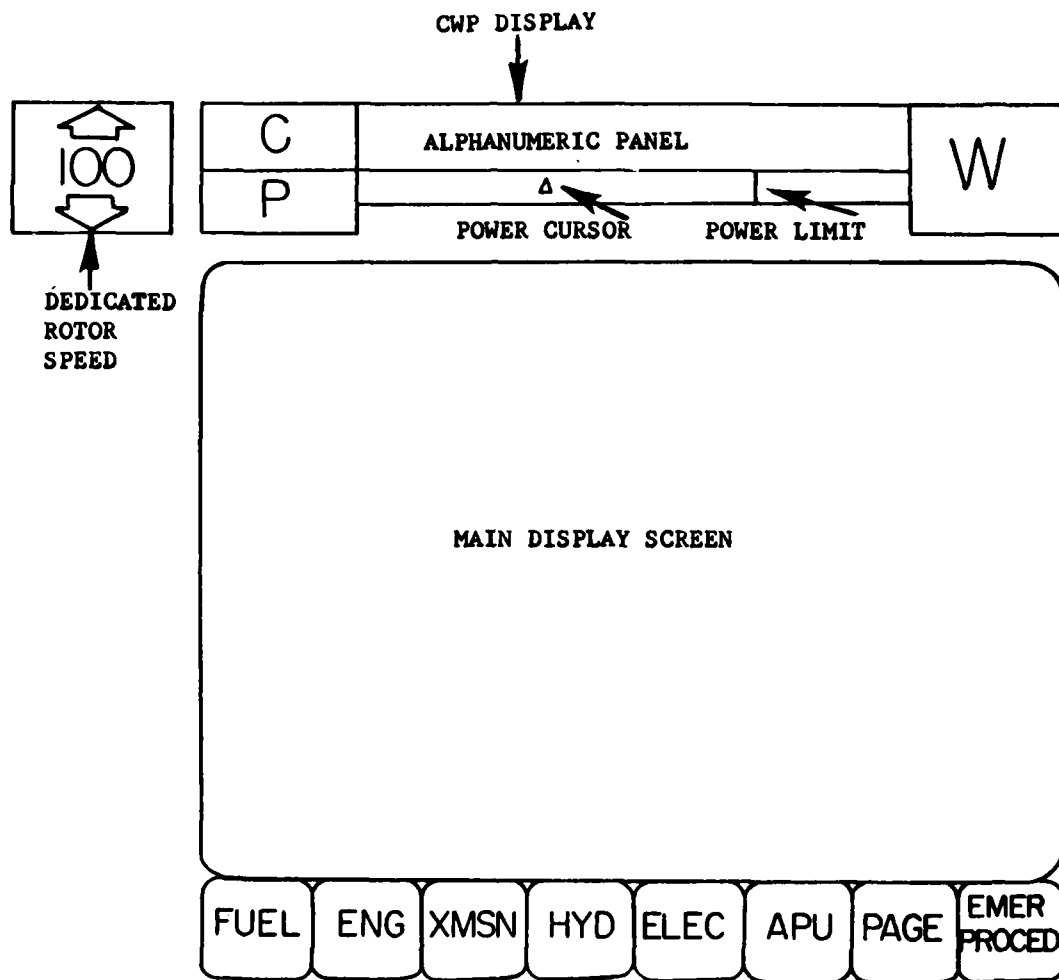
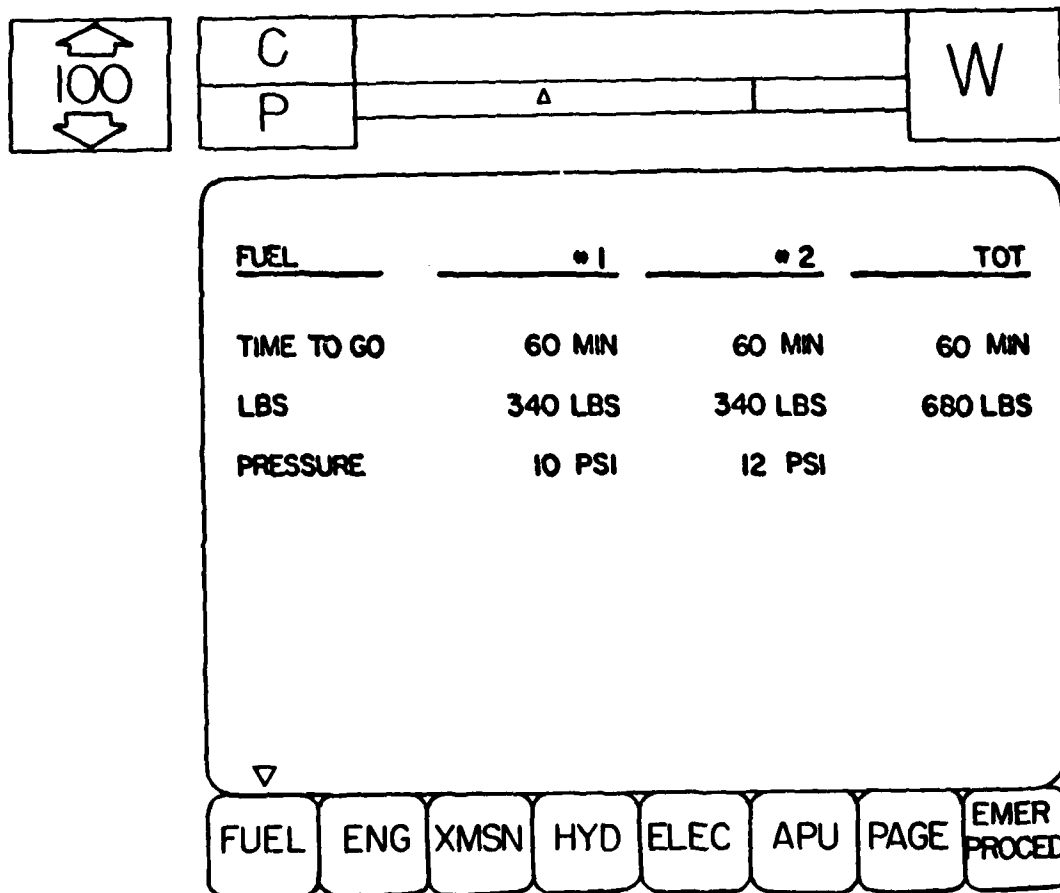
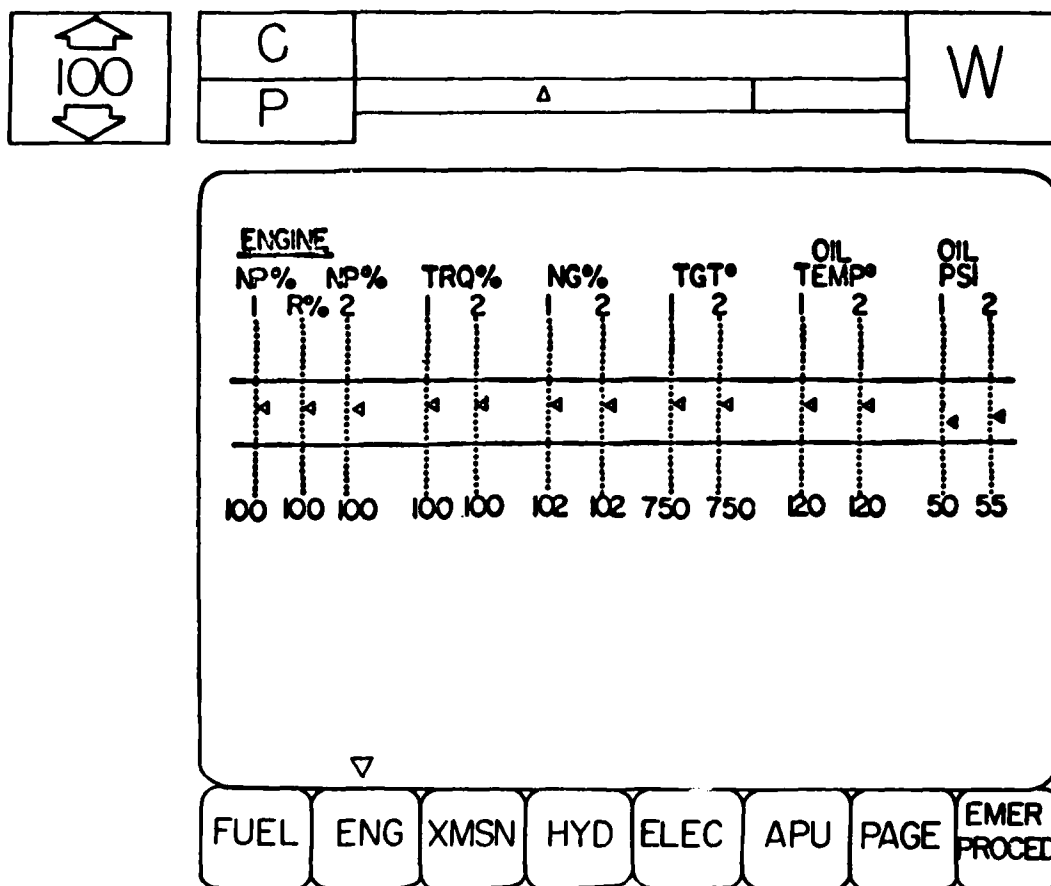


Figure 5. Subsystem Status Monitor display elements.



The FUEL display has been manually accessed. Manual access is indicated by the cursor above the FUEL button. For FUEL, ENGINE, XMSN, and APU, manually accessed display format is identical to the automatically displayed format.

Figure 6. Fuel system display.



The ENGINE system has been manually accessed. Scale markings have been eliminated, leaving only a dotted vertical line with vertically moving cursors for analog scales. All analog scales for related parameters are calibrated. Horizontal lines indicate upper and lower caution limits. Quantitative digital readouts are displayed beneath each analog scale.

Figure 7. Engine system display.

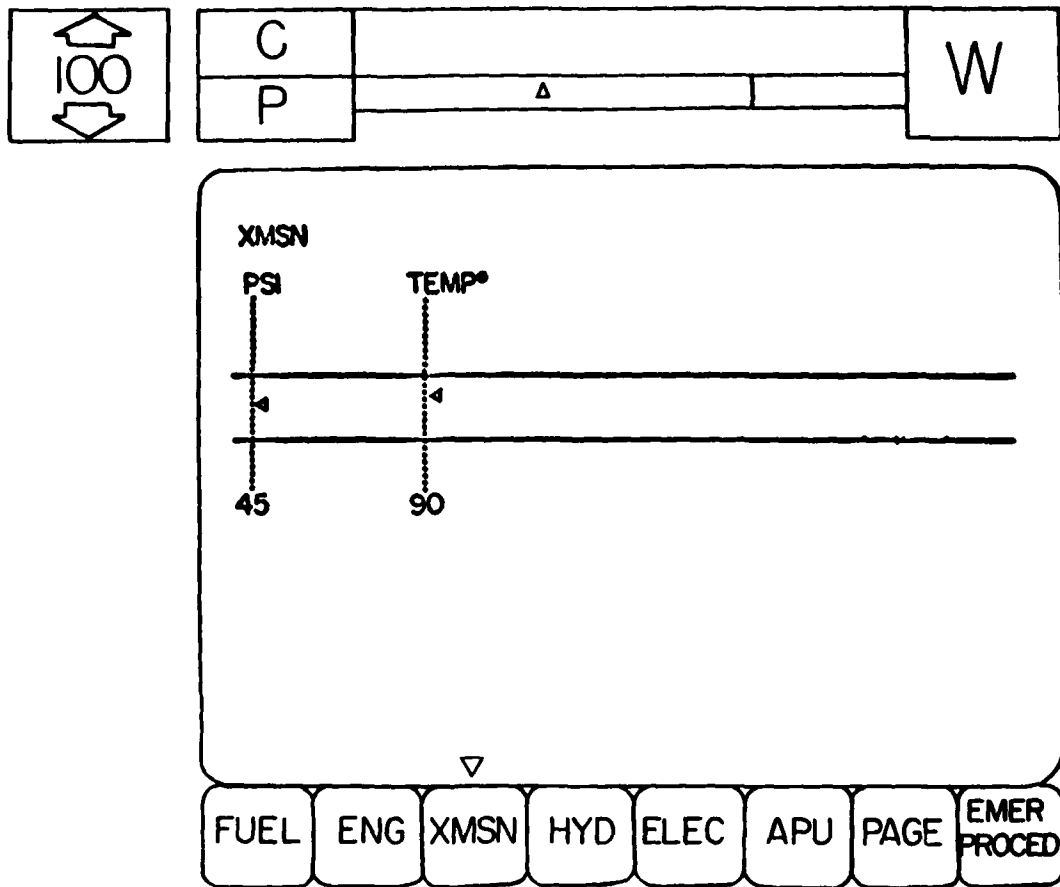
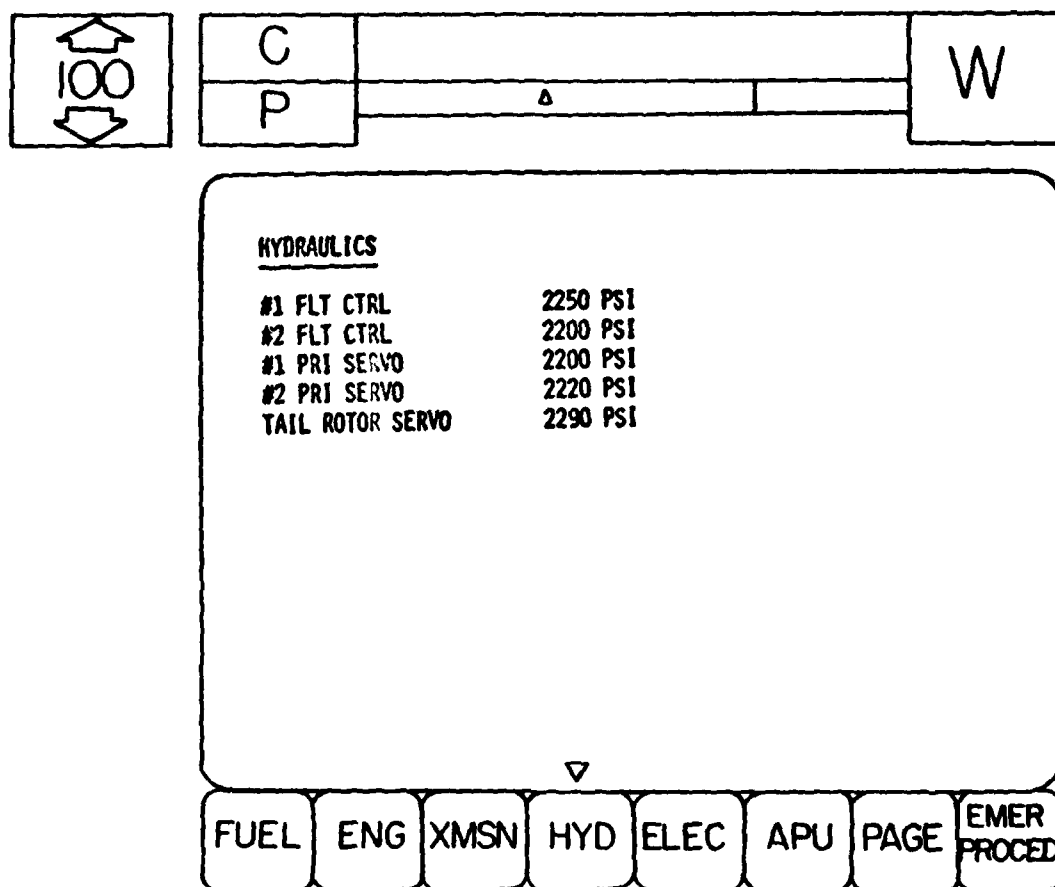
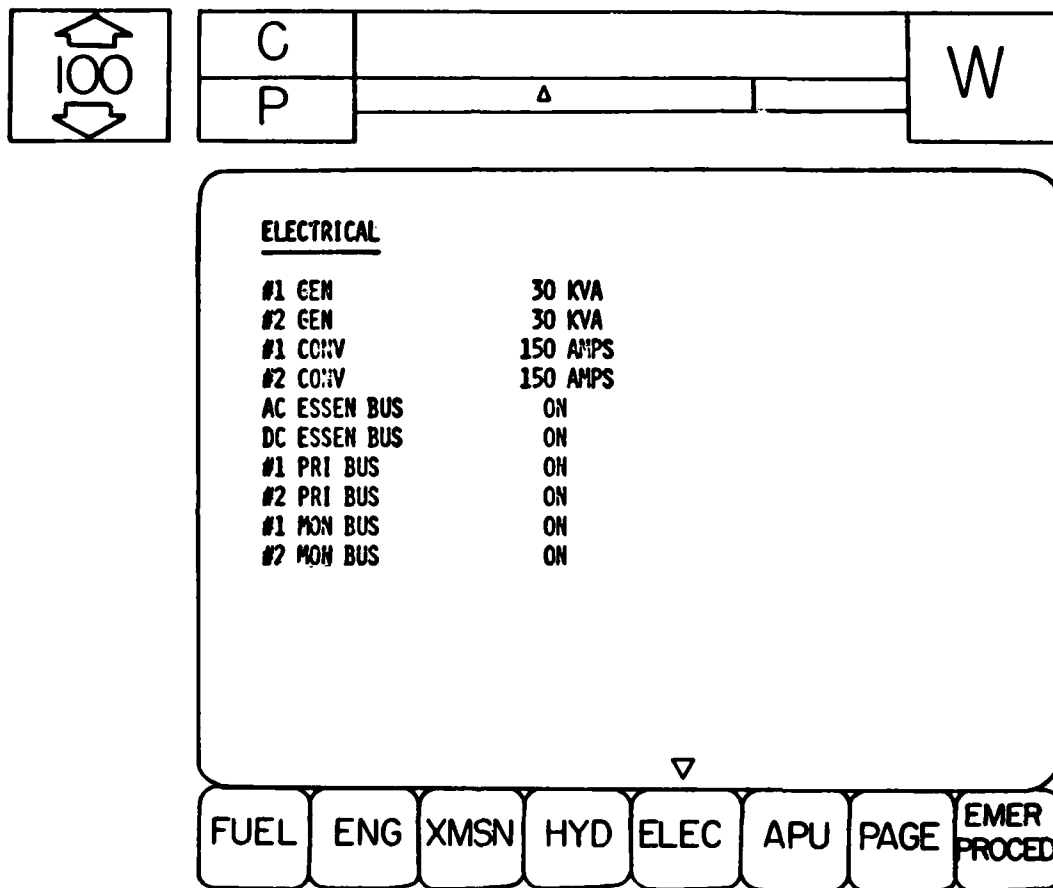


Figure 8. XMSN system display.



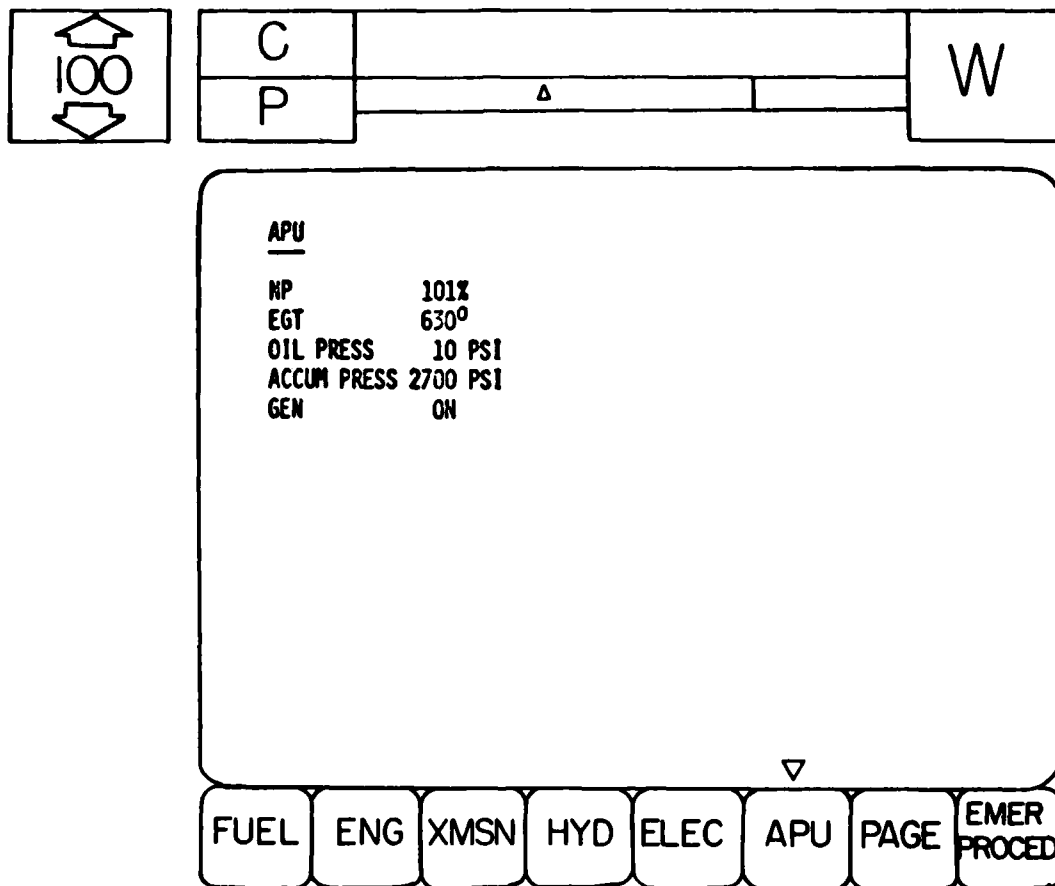
The HYDRAULICS system will be displayed only by manual access, though the status of individual parameters will be automatically displayed during caution conditions. No analog scales are displayed after manual access, and automatically displayed caution status messages do not include digital readouts.

Figure 9. Hydraulics system display.



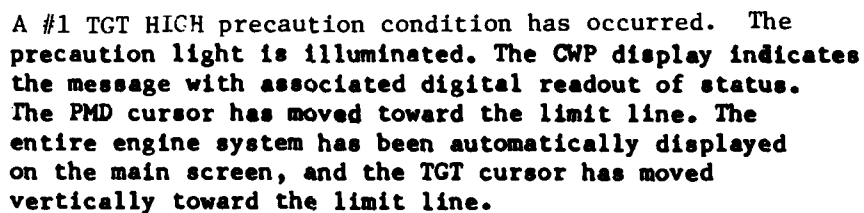
The ELECTRICAL system will be displayed only by manual access, though the status of individual parameters will be automatically displayed during caution conditions. No analog scales are displayed after manual access, and automatically displayed caution status messages do not include digital readouts.

Figure 10. Electrical system display.

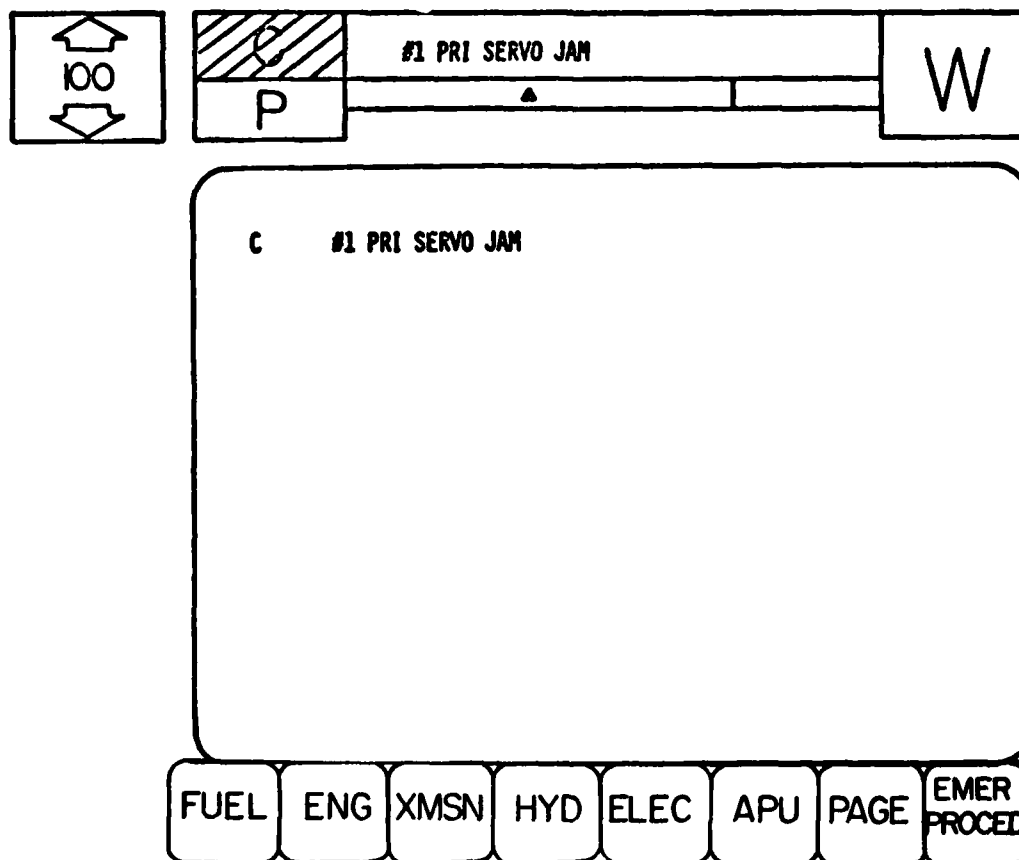


The APU system, like FUEL, ENG AND XMSN systems, will be automatically displayed when one of its parameters exceeds its limit, and may be manually accessed. No analog scales, however, are displayed for the APU system.

Figure 11. APU system display.

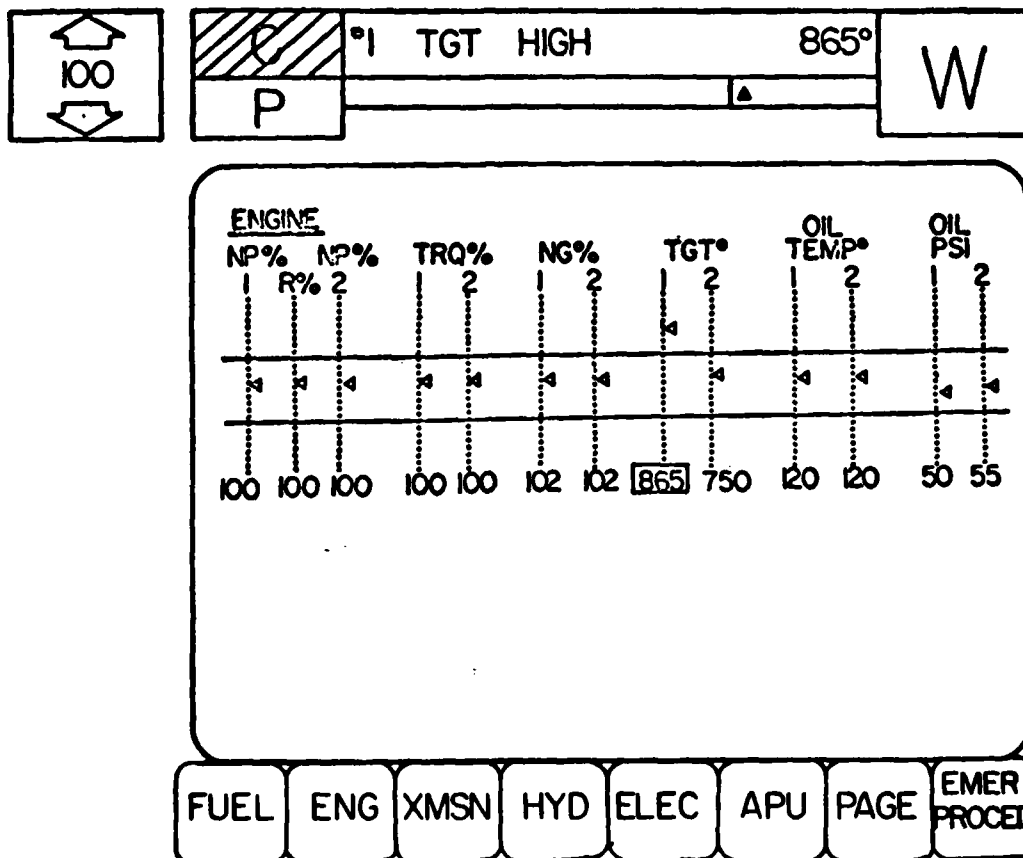


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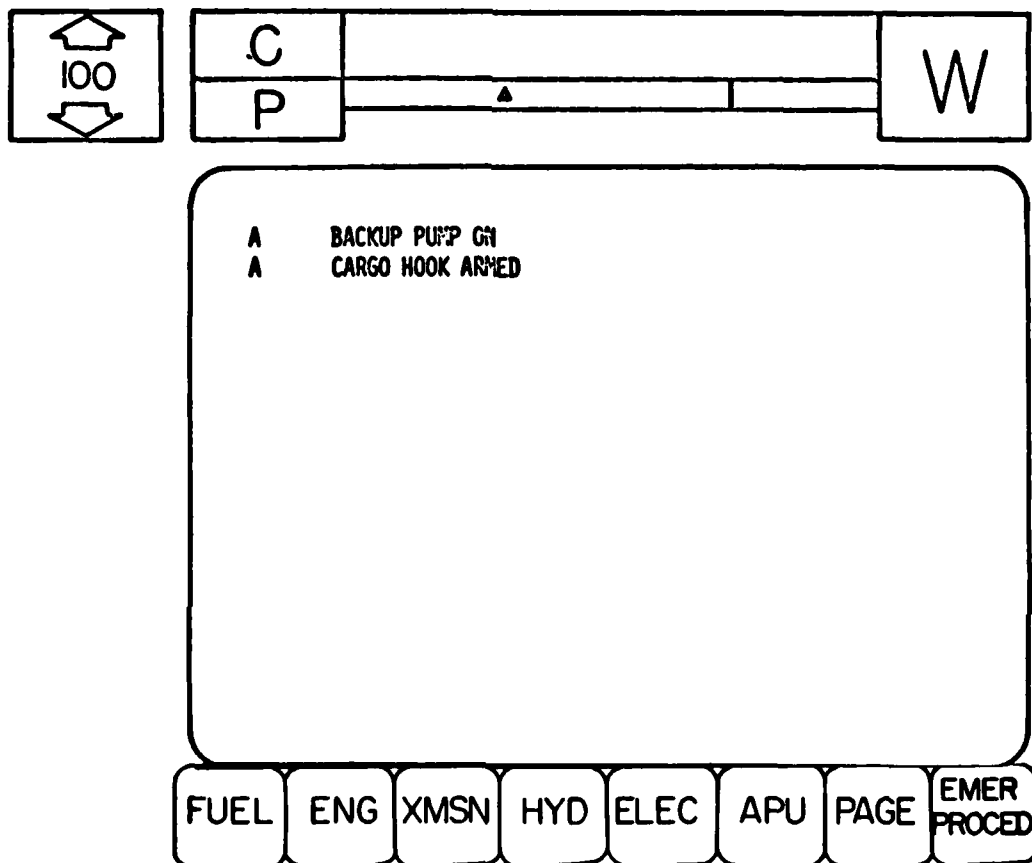
There are two sets of caution messages: those that automatically call up display of the entire system of which they are a part, and those which are displayed alone. Distinctions are identified in Tables 27 through 30 in Appendix A. #1 PRI SERVO JAM does not call up the entire hydraulic system. Its caution message is displayed on both the CWP and main displays. It will remain on the CWP so long as it represents the highest priority message, or is temporarily replaced by a later message of lower priority, and will remain on the main screen until the condition is corrected.

Figure 13. Sample caution display.



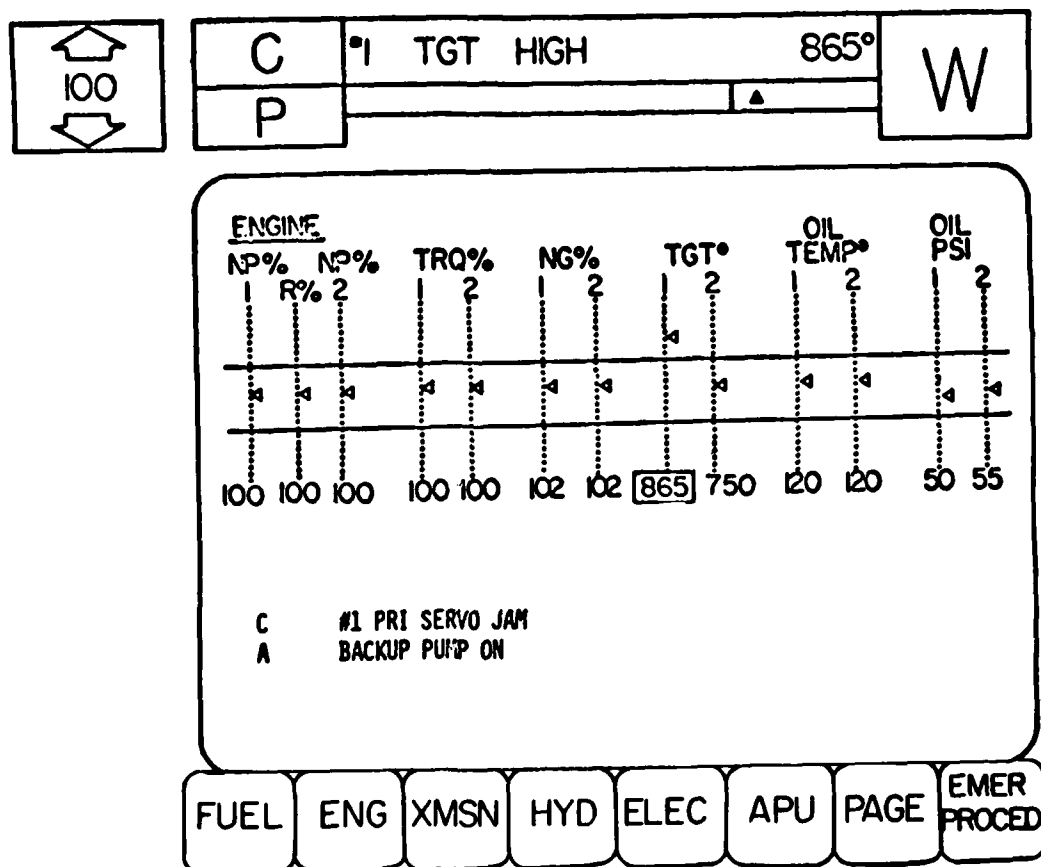
A #1 TGT HIGH caution condition results in automatic display of the engine system on the main screen, where the TGT cursor has moved beyond the limit line and the TGT digital readout has been boxed to highlight the overlimit parameter. The caution light is illuminated. The message and associated digital readout has appeared on the CWP display. The CWP will include digital readout of a parameter if that parameter calls up an entire system on the main screen. The power management cursor has moved beyond the limit line.

Figure 14. Sample caution display.



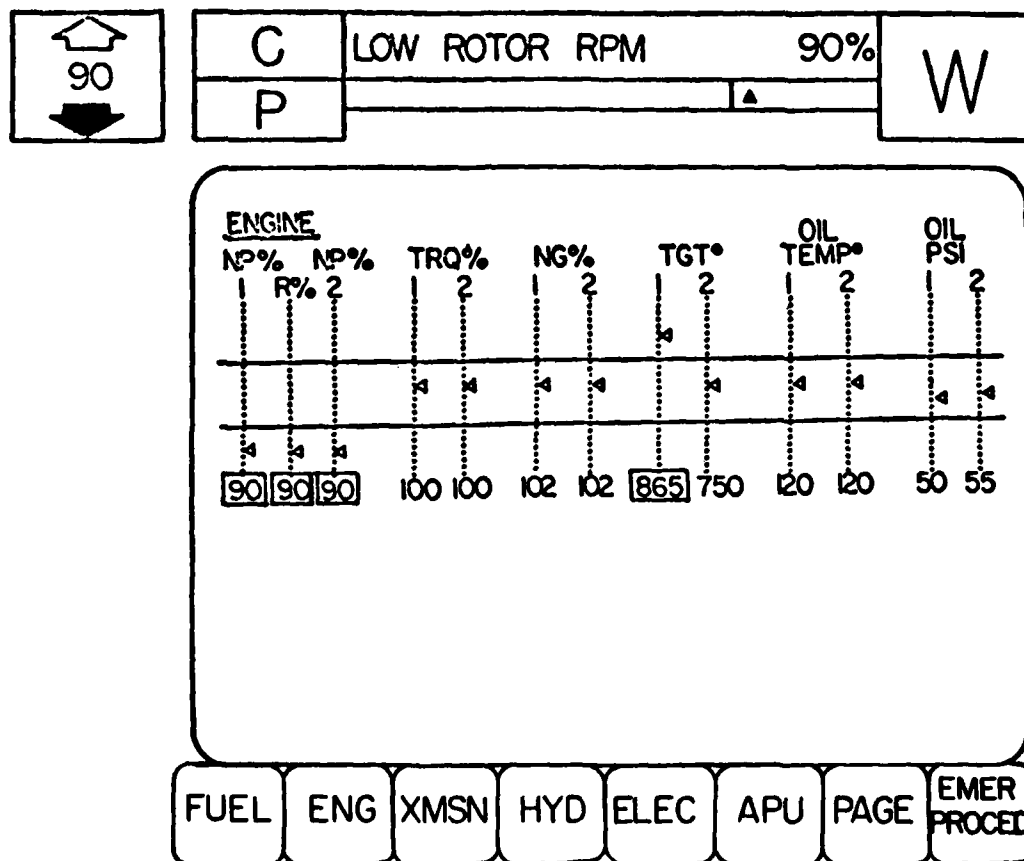
Advisory messages appear on the main screen only.

Figure 15. Sample advisory display.



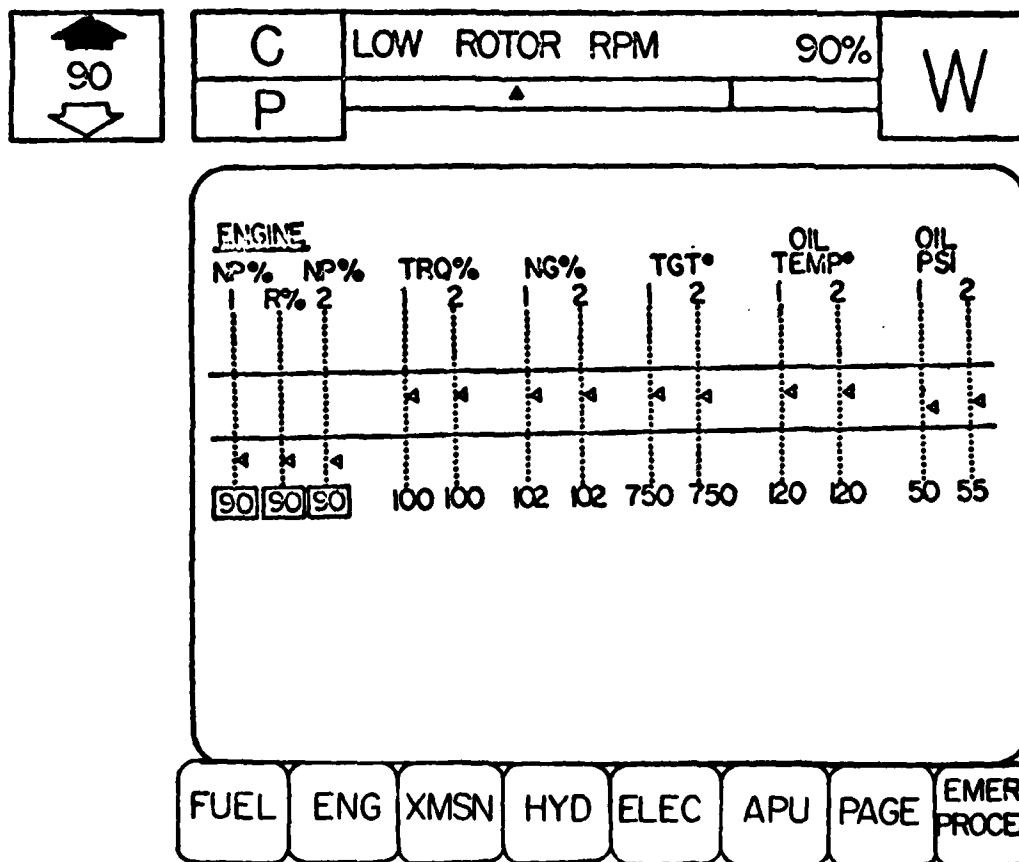
The caution light has been reset. The #1 TGT HIGH message, with digital readout, has remained on the CWP display, since it constitutes the highest priority message and no other subsequent messages are pending. The PMD cursor has moved beyond the limit line. The engine system parameters have been automatically displayed on the SSM display. The #1 TGT cursor has moved vertically beyond the caution line, and the digital readout has been boxed to highlight the caution condition. Prior caution (#1 PRI SERVO JAM) and advisory (BACKUP PUMP ON) messages have been vertically prioritized on the SSM display.

Figure 16. Illustration of prioritization.



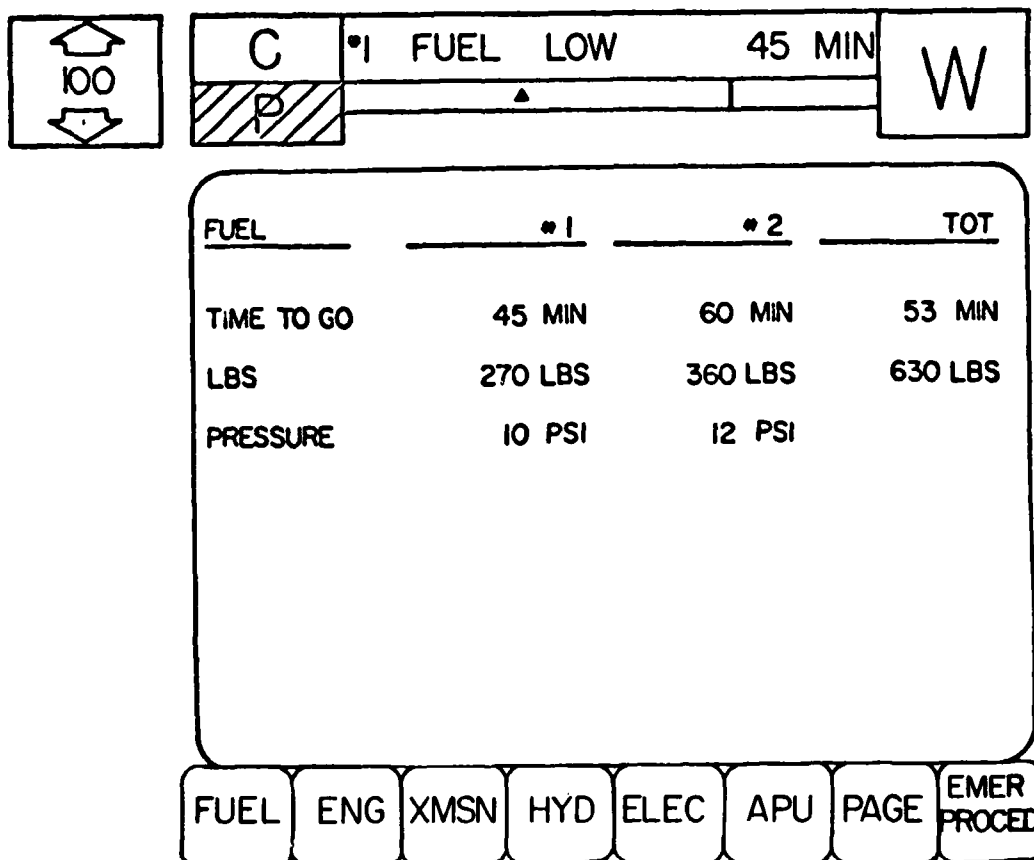
A LOW ROTOR RPM warning has occurred. The warning light has been reset. The LOW ROTOR RPM message continues, with digital readout, on the CWP display. The dedicated NR display presents rotor speed digitally, and the arrow indicates that NR is decreasing. The engine system parameters have been automatically displayed on the main screen. The main display shows NR in combination with decreased NP, and a current but previously announced #1 TGT caution. All are boxed for highlight, and relevant cursors have moved beyond limit lines.

Figure 17. Sample LOW ROTOR RPM condition.



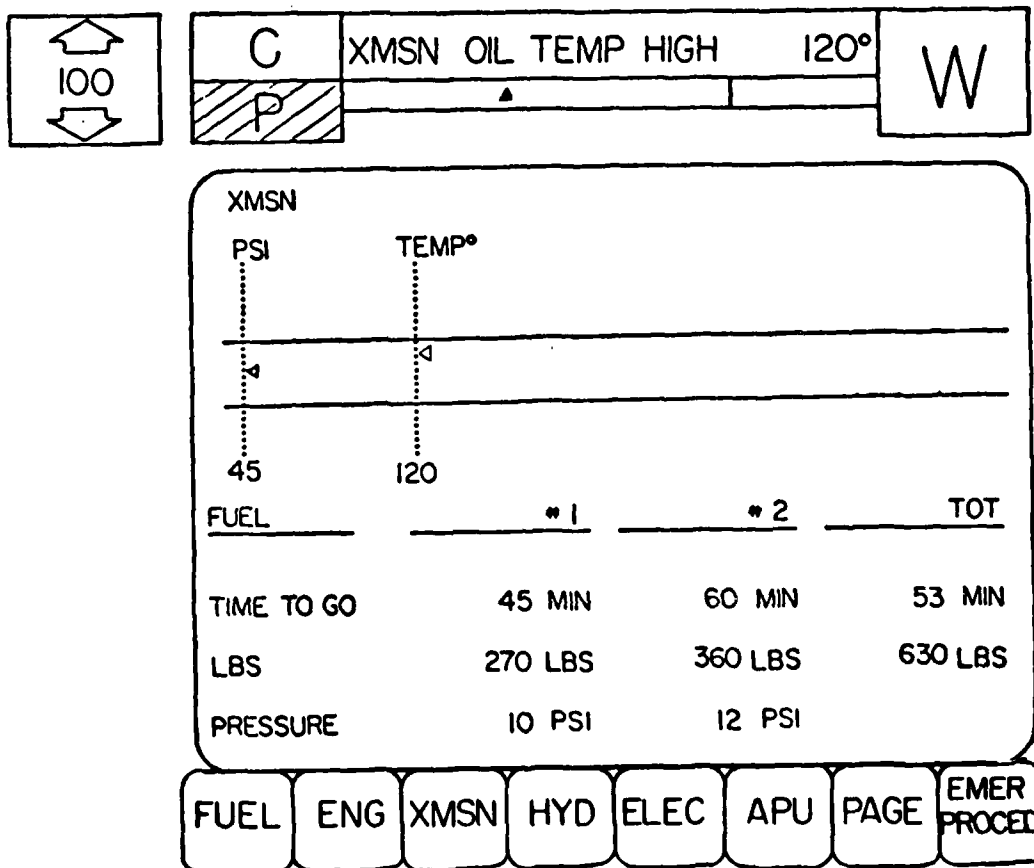
Rotor RPM is at 90% and increasing beyond a specified rate.

Figure 18. LOW ROTOR RPM condition.



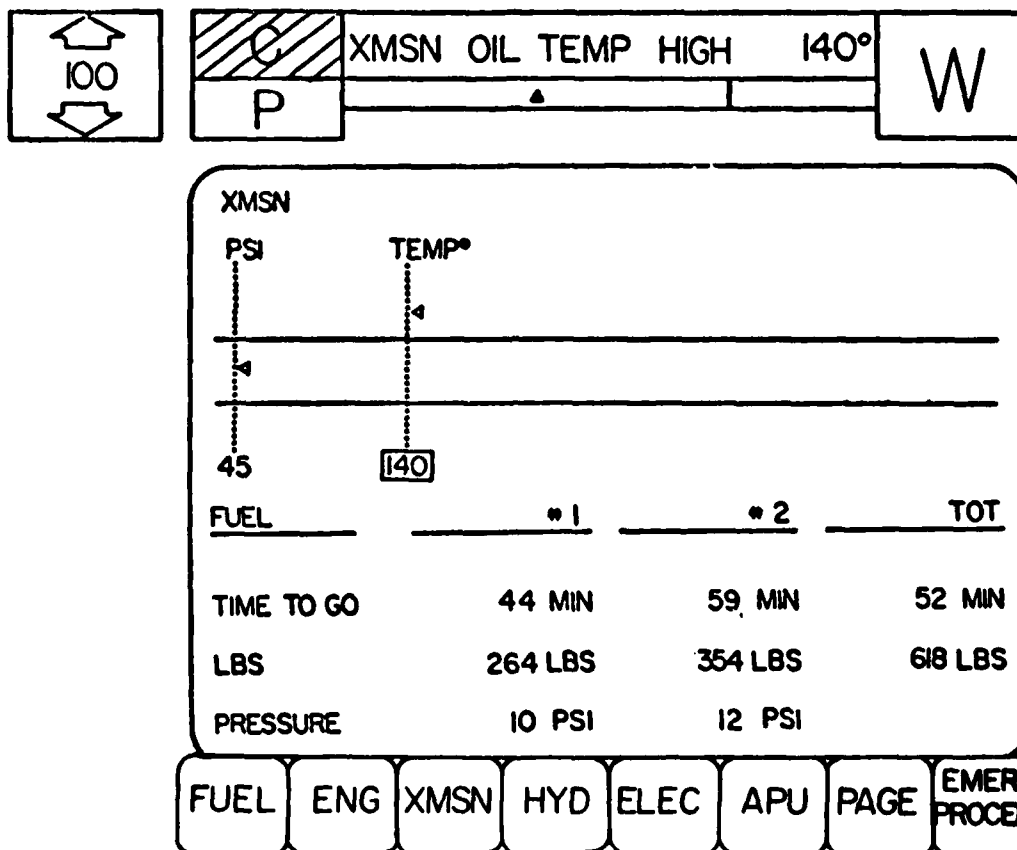
LOW FUEL precaution limit has been preset at 45 minutes. Presetting of the LOW FUEL precaution limit has been accomplished through the peripheral keyboard, described later in Task V. Tank #1 has been depleted to this level. The precaution light has illuminated and the fuel system has been automatically displayed on the main screen.

Figure 19. Sample scenario display.



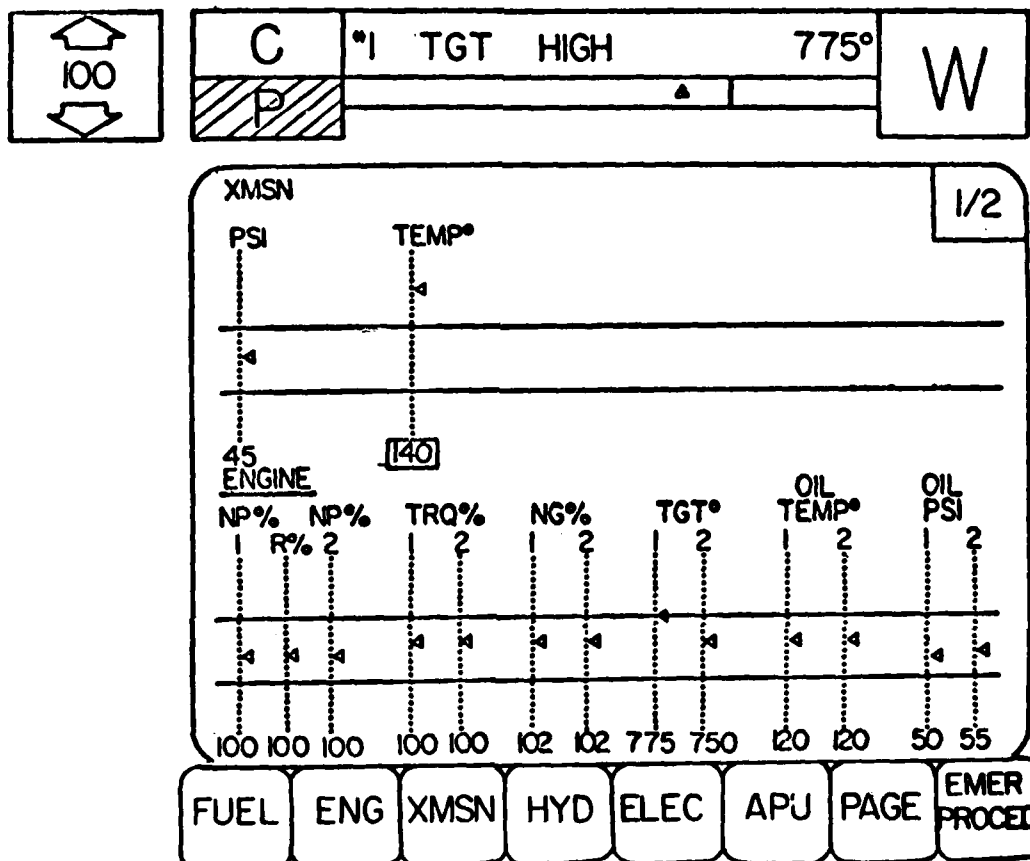
XMSN oil temperature has reached precaution limits. The precaution light has illuminated, and the XMSN OIL TEMP message and digital readout have appeared on the CWP display. On the main screen, the XMSN system has been automatically displayed, and the fuel system, which is in a lower priority, has moved down on the screen.

Figure 20. Sample scenario display.





XMSN oil temperature has reached the caution limit. The caution light has illuminated, and the XMSN OIL TEMP message and digital readout have been displayed on the CWP display. On the main screen, the XMSN TEMP digital readout has been boxed, and the cursor has moved above the limit line.

Figure 21. Sample scenario display.



#1 TGT has reached precaution limits. The precaution light has illuminated and the #1 TGT HIGH message and digital readout have appeared on the CWP display. The power management cursor has moved toward the limit line. On the main screen, the XMSN system, in a caution condition, maintains its priority. The engine system, of higher priority than the fuel system, has "bumped" the fuel system beyond the screen capacity. A "1/2" indication in the upper right hand corner of the main screen indicates that the first of two pages of screen information is currently displayed.

Figure 22. Sample scenario display.

  
 100  


C

XMSN OIL TEMP HIGH 140°

W

P

△

2/2

| FUEL       | * 1     | * 2     | TOT     |
|------------|---------|---------|---------|
| TIME TO GO | 40 MIN  | 55 MIN  | 47 MIN  |
| LBS        | 240 LBS | 330 LBS | 570 LBS |
| PRESSURE   | 10 PSI  | 12 PSI  |         |

FUEL

ENG

XMSN

HYD

ELEC

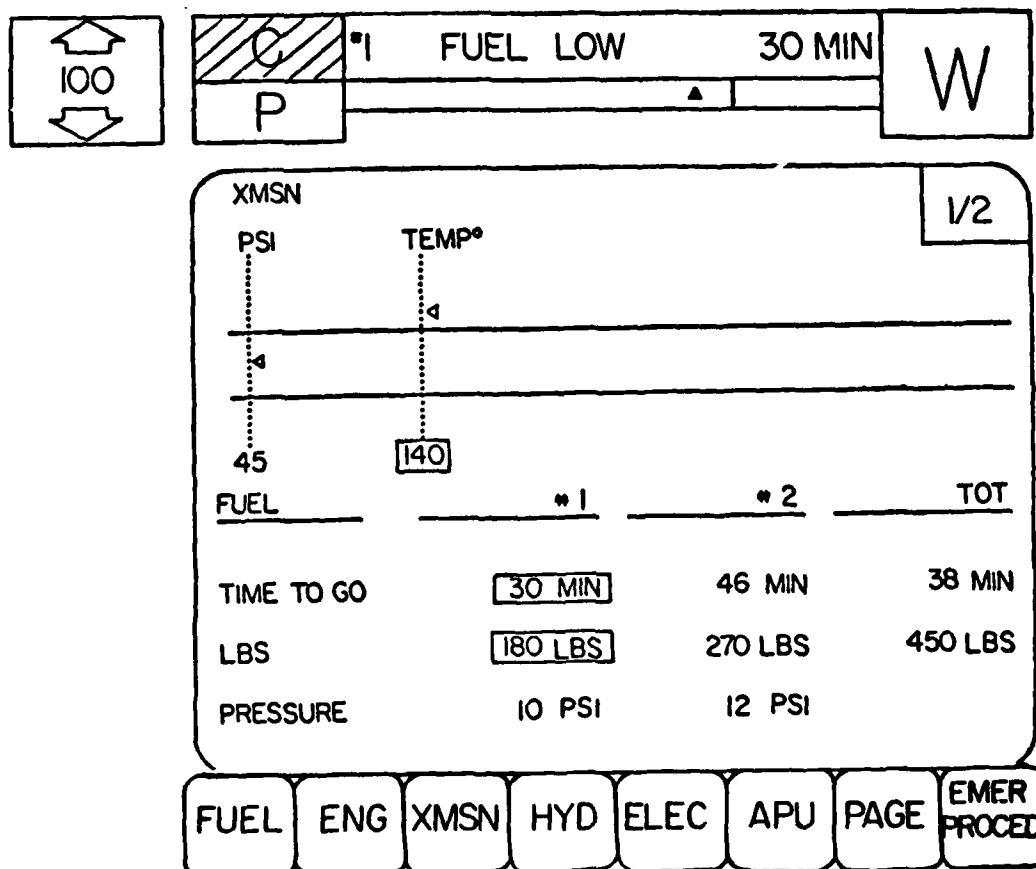
APU

PAGE

EMER  
PROCED

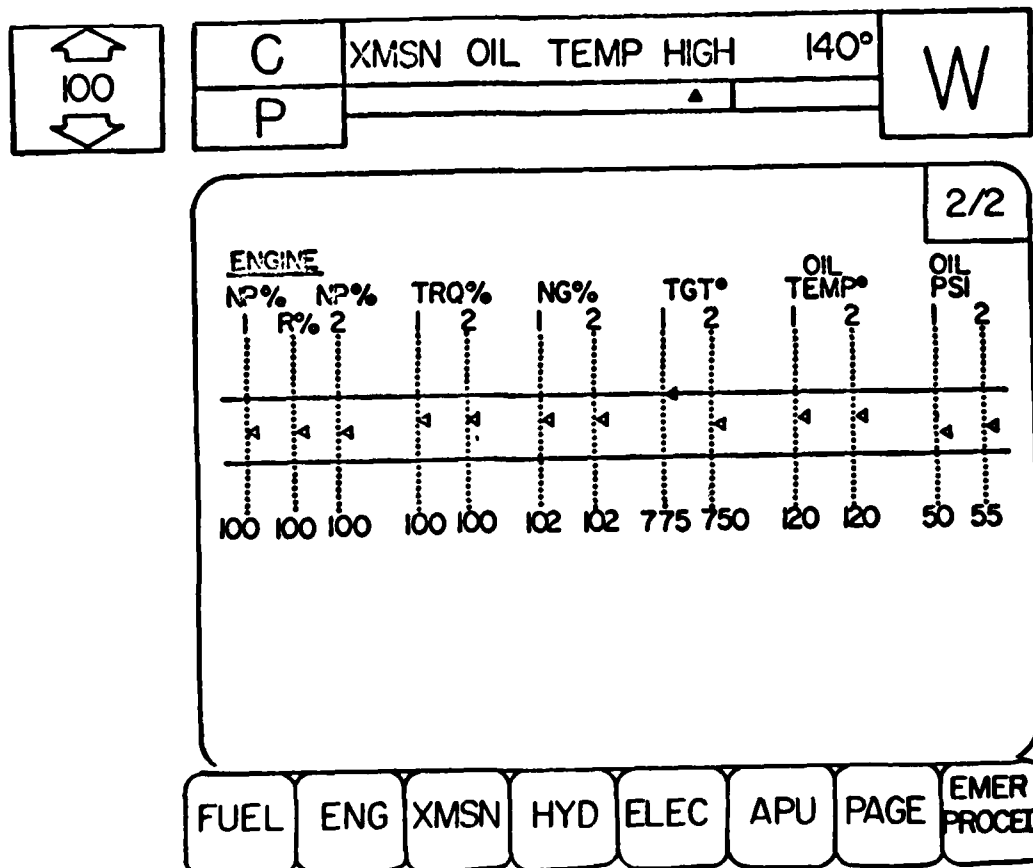
The precaution light has been reset. Page 2 of the main screen has been accessed by pressing the PAGE button. The XMSN OIL TEMP HIGH message remains of highest priority and is displayed on the CWP display. The power management cursor maintains its position. The "2/2" indication signifies that the second of two pages is being displayed.

Figure 23. Sample scenario display.



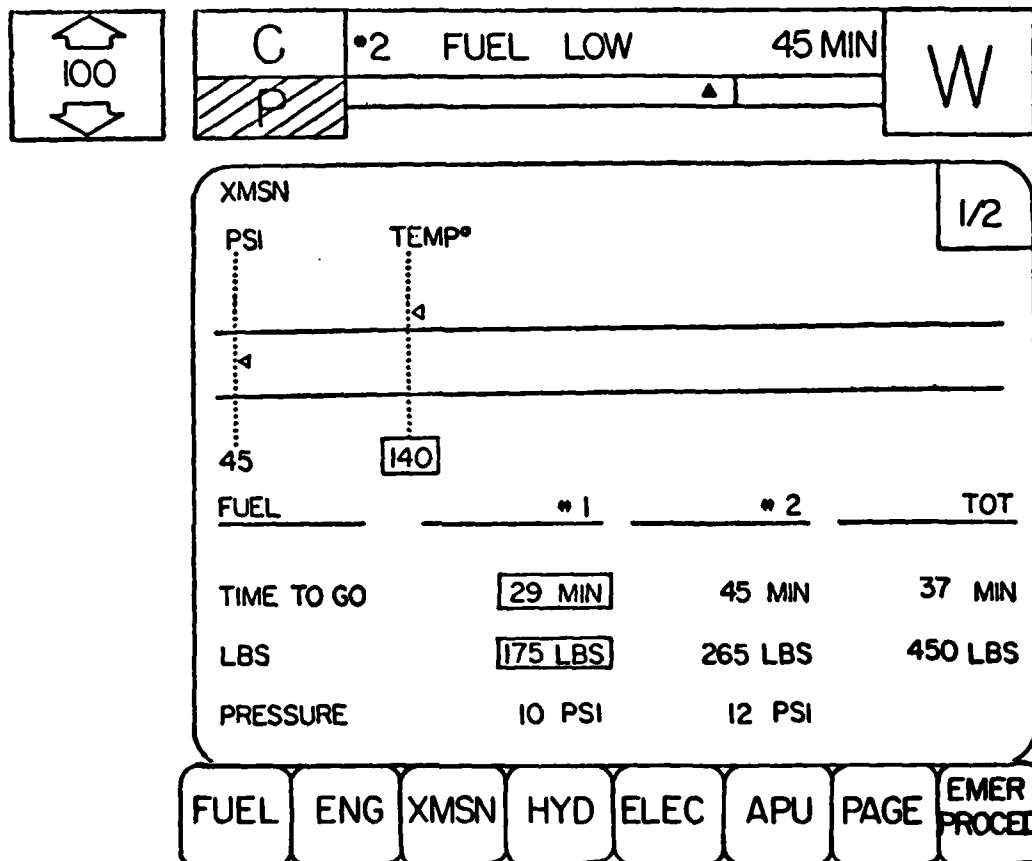
#1 FUEL has now reached the caution level. The caution light has illuminated and the #1 FUEL LOW message and digital readout have appeared on the CWP display. The PMD cursor maintains its position. Since fuel is now in a caution condition while engine remains in a precaution condition, fuel has "bumped" engine to Page 2. Fuel #1 TIME TO GO and LBS readouts on the main screen have been boxed for highlight. Page 1 has been manually reaccessed.

Figure 24. Sample scenario display.



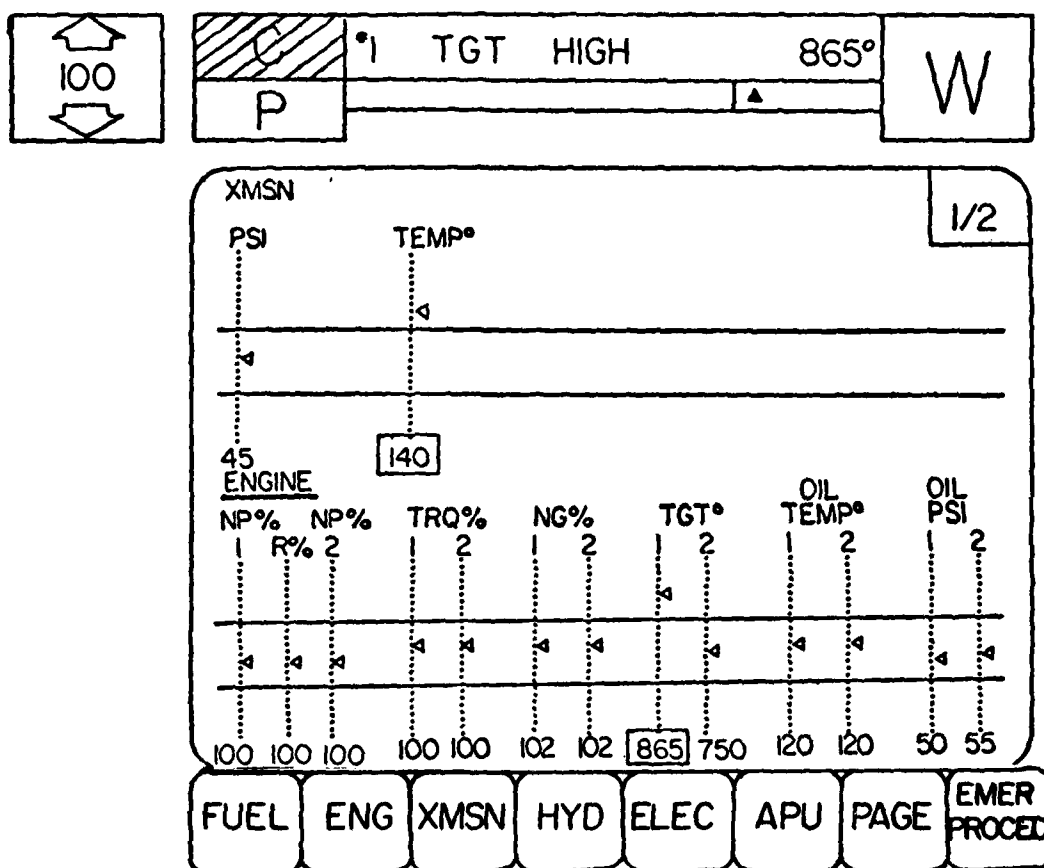
The caution light has been reset and the second page has been manually accessed. The XMSN OIL TEMP HIGH message remains of highest priority and has returned to the CWP display.

Figure 25. Sample scenario display.



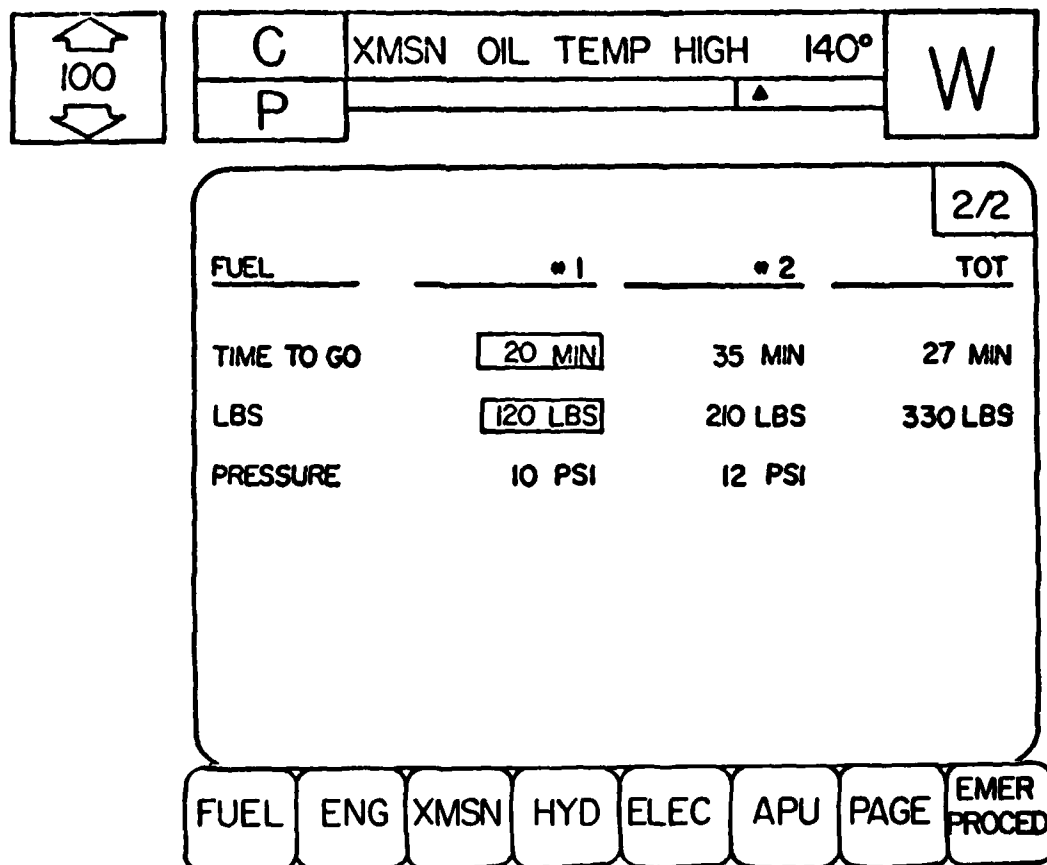
#2 FUEL has reached precaution level. The precaution light has illuminated, and the #2 FUEL LOW message and digital readout have appeared on the CWP display. Page 1 of the main screen has been manually accessed.

Figure 26. Sample scenario display.



#1 TGT has reached caution limit. The caution light has illuminated and the #1 TGT HIGH message and digital readout have appeared on the CWP display. The PMD cursor has moved beyond the limit line. On the main screen, the engine system has "bumped" the fuel system to Page 2. The TGT digital readout has been boxed for highlight and the cursor has ascended beyond the limit line.

Figure 27. Sample scenario display.



The caution light has been reset, and Page 2 has been manually accessed. The XMSN OIL TEMP HIGH message and digital readout have returned to the CWP display. The PMD cursor has remained beyond the limit line.

Figure 28. Sample scenario display.

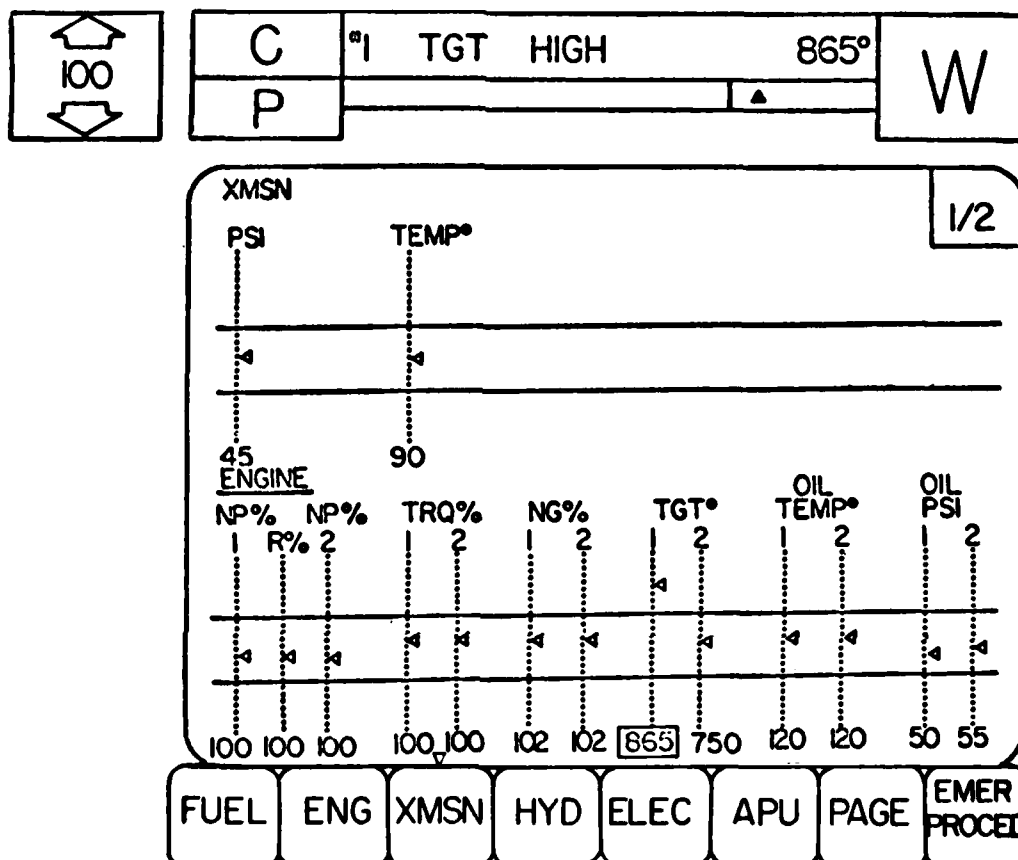
|             |   |             |      |   |
|-------------|---|-------------|------|---|
| <br>100<br> | C | *1 TGT HIGH | 865° | W |
|             | P |             |      |   |

| ENGINE     |       |        |       | OIL TEMP° |         | OIL PSI |     |
|------------|-------|--------|-------|-----------|---------|---------|-----|
| NP% 1      | NP% 2 | TRQ% 2 | NG% 2 | TGT° 2    | 2       | 2       | 2   |
| 100        | 100   | 100    | 102   | 102       | 865     | 750     | 120 |
| 100        | 100   | 100    | 102   | 102       | 865     | 750     | 120 |
| FUEL       |       |        |       | *1        | *2      | TOT     |     |
| TIME TO GO |       |        |       | 18 MIN    | 33 MIN  | 26 MIN  |     |
| LBS        |       |        |       | 108 LBS   | 198 LBS | 306 LBS |     |
| PRESSURE   |       |        |       | 10 PSI    | 12 PSI  |         |     |

|      |     |      |     |      |     |      |                |
|------|-----|------|-----|------|-----|------|----------------|
| FUEL | ENG | XMSN | HYD | ELEC | APU | PAGE | EMER<br>PROCED |
|------|-----|------|-----|------|-----|------|----------------|



The XMSN oil temperature has returned to within normal limits and has disappeared from the CWP and main displays. The #1 TGT HIGH condition is now of highest priority and is displayed on the CWP display. The PMD cursor remains beyond the limit line. Engine and fuel systems are prioritized and displayed on the main screen.

Figure 29. Sample scenario display.



The XMSN system has been manually accessed and appears at the top of the main screen. A cursor above the XMSN button indicates the manual access. The fuel system has been "bumped" to Page 2, and a "1/2" indication has appeared. The #1 TGT HIGH message remains on the CWP display, and the PMD cursor remains beyond the limit line.

Figure 30. Sample scenario display.

  
 100  



C

#1 TGT HIGH

865°

W

P



2/2

| FUEL       | #1      | #2      | TOT     |
|------------|---------|---------|---------|
| TIME TO GO | 18 MIN  | 33 MIN  | 26 MIN  |
| LBS        | 108 LBS | 198 LBS | 306 LBS |
| PRESSURE   | 10 PSI  | 12 PSI  |         |

FUEL

ENG

XMSN

HYD

ELEC

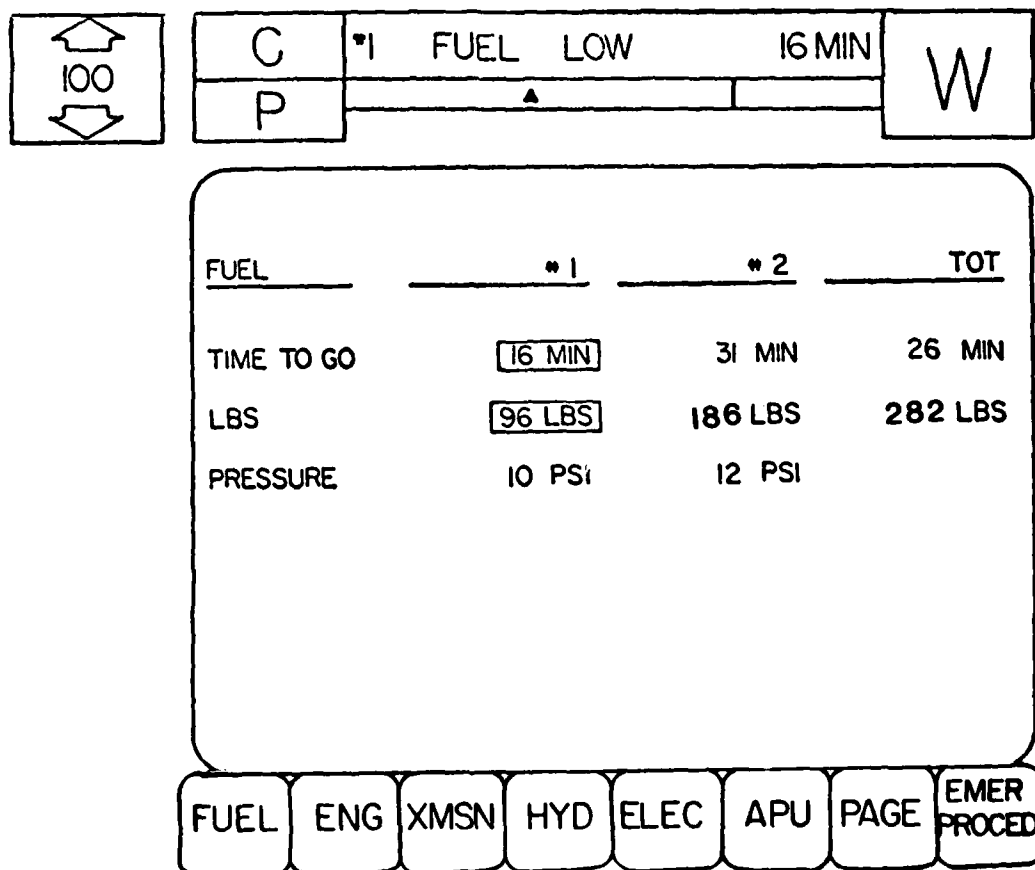
APU

PAGE

EMER  
PROCED

Page 2 has been accessed, and the fuel system is displayed. A "2/2" indication has appeared. The CWP #1 TGT HIGH display and the PMD cursor remain unchanged.

Figure 31. Sample scenario display.



#1 TGT has returned to within normal limits, and TGT displays have disappeared from the CWP and main displays. There is no display overflow to a second page. The XMSN system has been removed from the main screen by a second depression of the XMSN button. Only the fuel system now involves exceedance. The #1 FUEL LOW message and digital readout appear on the CWP display, and the fuel system is displayed on the main screen.

Figure 32. Sample scenario display.

### Evaluation Of Control Allocation Concepts

"Control allocation" is a term referring to the decision-making algorithms by which a computer monitors system operation, decides when corrective response is required, and decides whether to perform the corrective response by itself or to inform the human operator of the condition, allowing him to perform the response. In advanced control allocation schemes, the computer adjusts its algorithms in a fashion analogous to human learning, by monitoring the consistency and effectiveness of the human operator's responses. In view of the long-term nature of such control allocation concepts and current pilots' preference for human as opposed to machine (computer) control over in-flight decision-making, control allocation was judged to be beyond the scope of the SSM as presently envisioned. It is, however, predicted that in the long term, control allocation concepts will be found more applicable to such functions as subsystem monitoring, and a detailed discussion of control allocation concepts is presented in Appendix C.

### Determination Of Most Effective Means Of Displaying Emergency Procedures.

The display of emergency procedures in response to warning and caution conditions was investigated as a potentially useful feature of the SSM that would contribute to the reduction of crew workload and the enhancement of mission effectiveness. Helicopter pilots at Ft. Rucker, Alabama, ruled out a system logic that would display emergency procedures automatically in response to the occurrence of warning and caution conditions, but confirmed that an SSM feature permitting manual access of emergency procedures would reduce crew workload and enhance mission effectiveness. Though the SSM design includes an EMER PROCED button beneath the main screen for accessing emergency procedures, the mode of operation of the EMER button and related emergency procedures display formats are discussed in detail in Task V.

### TASK III: PRELIMINARY DESIGNS

Three preliminary designs of system architecture were prepared using the UH-60A as a case study. System unit functions will be discussed in detail for the first design, and features that differ for the second and third designs will also be discussed in detail.

The three preliminary designs were identified as follows:

1. Current: Technology is currently available for constructing all system components described, though some development would be required for the specific applications identified.
2. Near-term: It is predicted that the technology required for construction of some of the system components described will be available subsequent to development within 5-10 years.
3. Long-term: It is predicted that the technology required for construction of several of the system components described will not be available within 10 years.

Though the three designs have been distinguished by temporal labels, it must be noted that temporal predictions of availability of electronic technology are difficult at best. The development of flat panel display technology, for example, has lagged behind previous industry predictions, though imminent solutions are constantly being promised. The development of computerized voice interactive systems (speech recognition and speech synthesis) has involved sudden breakthroughs, though application problems currently exist whose solution time is difficult to predict accurately.

Fiber-optics data transmission is currently a reality, though aircraft applications of fiber-optics data bussing must still face such problems as signal loss and connector efficiency.

The difficulty of predicting the time factor is not limited to hardware. Though airborne computers are currently a reality, such problems as sensor failure analysis through systems modelling require powerful software programs whose development time is difficult to predict.

Therefore, although the three preliminary designs have been distinguished by temporal labels, they are best distinguished by their distinctive components. Were all required hardware and software currently available, the second design offers more mission effectiveness than the first, and the third more than the second.

#### CURRENT DESIGN

The architecture of the current design is presented in Figure 33.

#### Caution/Warning/Precaution Display (CWP Display)

C/W/P lights are provided for both pilot and copilot. Triggers for C/W/P lights are identified in Tables 35 through 38 in Appendix A. Caution and Warning lights are triggered by exceedance of predefined limits. The Precaution light is triggered by a combination of exceedance of predefined limit and rate of parameter movement toward a predefined caution limit. The predefined precaution limit for a FUEL LOW precaution may be redefined by pilot or copilot through the peripheral keyboard described in Task V. Pilot and copilot CWP lights and displays are

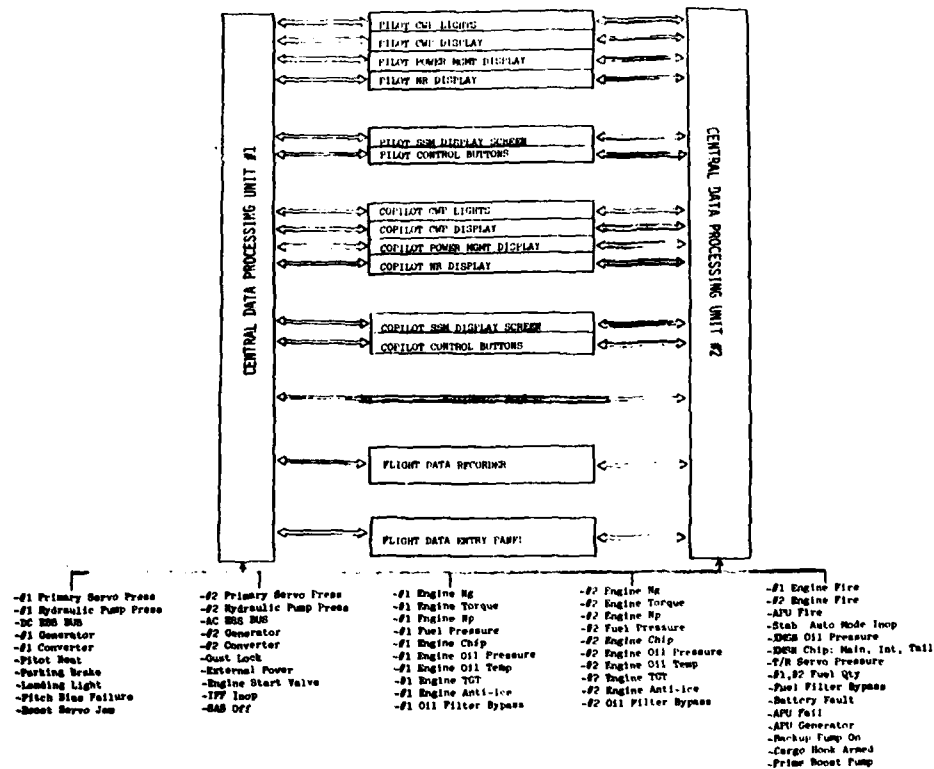


Figure 33. Current design architecture.

interconnected, but redundant. Resetting of CWP lights by either crew member accomplishes resetting for the other crew member's display as well. CWP messages and their prioritization are defined in Tables 27 through 30 and 35 through 38 in Appendix A. Operation of the CWP display was illustrated in Task II.

#### Power Management Display (PMD)

A PMD accompanies each CWP display. Operation of the PMD was illustrated in Task II.

#### Rotor RPM Display (NR Display)

An NR display provides dedicated digital readout of NR to both pilot and copilot. Operation of the NR display was illustrated in Task II.

#### Main SSM Display Screen (SSM Display)

A Main SSM display is provided for both pilot and copilot, for the display of system-related parameters, prioritized CWP messages, manually accessed subsystem information, and peripheral information. Information displayed on the Main SSM display is itemized and prioritized in Tables 27 through 30 and 35 through 38 in Appendix A. Related system parameters are defined in Tables 27 through 30 and Tables 31 through 34 in Appendix A. Peripheral information and display formats are defined in Task V. Operation of the Main SSM display and associated screen control buttons was illustrated in Task II. Operation of a peripheral keyboard associated with the Main SSM display is illustrated in Task V.

#### Flight Data Recorder (FDR)

An onboard FDR will automatically record the following information whenever an out-of-tolerance condition occurs for parameters so identified in Tables 27 through 30 in Appendix A, and during the course of that condition: status of out-of-tolerance parameter, time of occurrence, duration of condition, and cumulative frequency of condition occurrence since most recent playback. In addition, for specified parameters the FDR will also record the condition of related parameters. Table 39 in Appendix A lists these parameters for the UH-60A. Recording is terminated when all related parameters have returned to within normal limits. Manually directed recording may be accomplished through a RECORD switch located on the peripheral Flight Data Entry Panel keyboard, and terminated by a second depression of the switch. It is anticipated that playback of recorded flight data will be accomplished through plug-in peripheral devices, though changes in the Flight Data Entry Panel could be made to allow for command of on-board playback on the Main SSM display.

#### Flight Data Entry Panel (FDEP)

The FDEP is a peripheral function device whose operation will be discussed in detail in Task V. A removable and stowable FDEP is provided for both pilot and copilot for entering and accessing data for performance

calculations, checklists other than emergency procedures, and weight monitoring. The FDEP will be linked to the Central Data Processing Units through an electronic umbilical cord, when on-board, and may be used as a performance calculator during flight briefings, when unplugged.

#### Central Data Processing Units (CDPU's)

Two CDPU's will perform digital conversion of analog sensor signals, process digitized sensor data by comparison with preestablished limits, perform self-BIT and command BIT for displays, provide symbol generation for displays, provide prioritization logic for displays, provide displays and controls with data logic and synchrony, provide computation capability for performance monitoring, store checklists and procedures for display, scale simultaneously displayed analog formats and digital displays, provide commands and data to the FDR, and perform sensor failure analysis.

Sensor failure analysis will be performed through modelling procedures and/or sensor comparisons. For engine parameters, a mathematical model of the engine will be programmed into the CDPU's and all monitored parameters will be inserted into the model. Any parameter that does not conform to the model will be considered invalid and its sensor will be considered inoperative. Where practical, multiple redundant sensors will be used and by comparison of data received, the appropriate operating sensor will be selected. Sensor failures will be recorded by the FDR. Where failed sensors result in inability to report reliable messages to the crew, sensor failure will be announced. Prioritization of announced sensor failure messages will be identical to the warning or caution priority of the corresponding parameter.

#### Data Transmission

Signal sources for the UH-60A are included in Figure 33. Each sensor is wired directly to each CDPU. Where sensor failure analysis requires triply redundant sensors, this redundancy will be provided. Each CDPU is directly wired to each display and set of controls. In addition, CDPU's are interlinked, sharing functions and passing control.

#### NEAR-TERM DESIGN

Figure 34 illustrates system architecture for the near-term design. Multiplexed electronic data transmission was employed in the near-term design on the basis of the following predicted advantages of multiplexing:

1. Improved reliability through redundancy, high reliability components, fewer components, and improved component derating and thermal design.
2. Reduced electromagnetic interference (EMI): Fewer and shorter wires mean less EMI pickup surfaces; simple two-wire busses can be easily and more extensively shielded; and pulsed digital signals are inherently less susceptible to EMI than conventional analog signals.
3. Enhanced maintainability: Multiplex systems continuously check the validity of transmitted and received signals and can be programmed to display discrepancies.

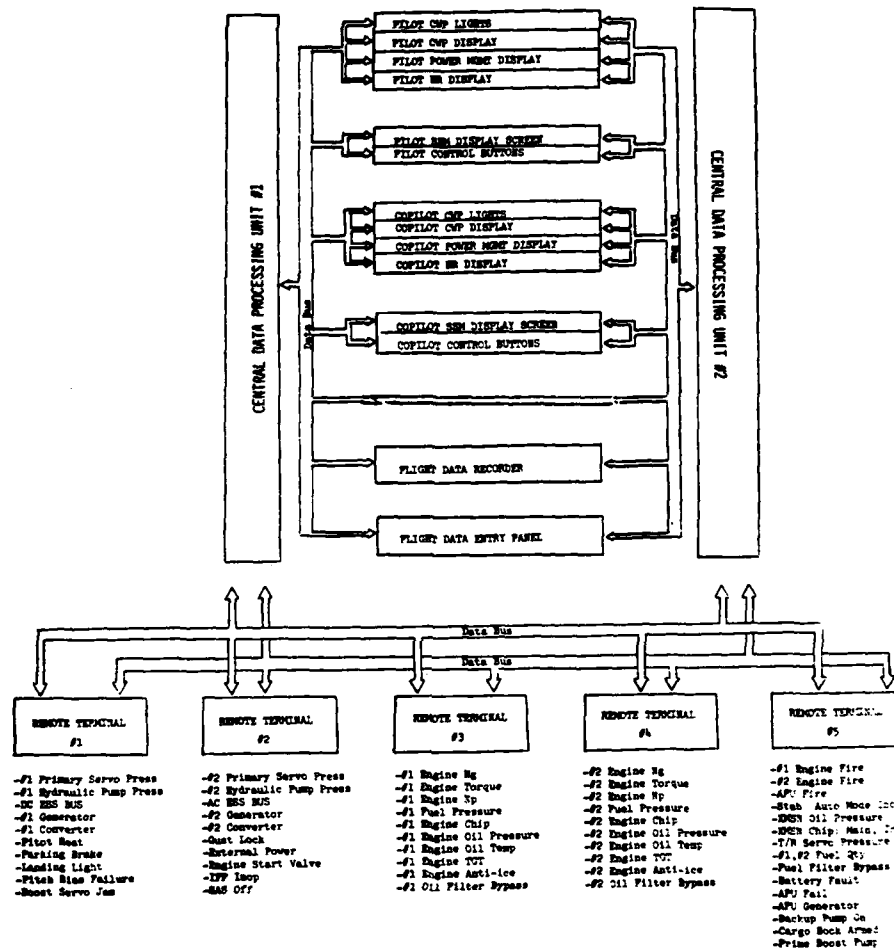


Figure 34. Near-term design architecture.

4. Improved survivability: Redundant and separate units, reduced number of components, and fewer and shorter associated wiring results in an estimated 50% reduction of system-presented areas.

5. Improved flexibility: Software changes instead of extensive aircraft modifications required to add future systems; equipment can be located at optimum location for performance, balance, etc., without wiring constraints; and reconfiguration for specific missions is simplified.

The near-term design is identical to the current design with the exception of the use of multiplexed data bussing for data transmission and the inclusion of remote data processing terminals.

#### Remote Terminals (RT's)

Five RT's perform the following functions: analog to digital conversion of sensor signals, sensor failure analysis, data storage for transmission to CDPU's upon command, and BIT as commanded by CDPU's.

The internal system will be tested by programming the CDPU to insert test words periodically into the sensor inputs of the RT's. The RT's will process these test words as though they were received from the sensors. When the test word is received back at the CDPU, it will be compared to the test word sent, and any discrepancy will indicate a channel fault. The channel fault will be relayed to the FDR, and sensor data through that channel will not be accepted by the CDPU.

#### Data Transmission

Sensors are grouped and wired directly to their respective RT's. Data is transmitted between RT's and CDPU's through dual redundant electronic data busses. Data between CDPU's and all displays and controls, the FDR, and the FDEP is also transmitted through electronic data bussing. The bussing architecture is defined in Figure 34.

While Figure 34 represents the SSM as a closed system, it must be noted that both near-term and long-term data busses are likely to be shared with other aircraft systems, as are the CDPU's. It is beyond the scope of this effort to define these other systems or their interaction with the SSM.

#### LONG-TERM DESIGN

Figure 35 illustrates the system architecture for the long-term design. The long-term design is identical to the near-term design except for the use of fiber-optics data bussing for data transmission and the addition of auxiliary Voice Warning and Voice Recognition systems.

#### Data Transmission

In the long-term design, fiber-optics data bussing replaces the near-term electronic data bussing. Properties of fiber-optics data transmission are compared with properties of electronic data transmission in Table 40 in Appendix A.

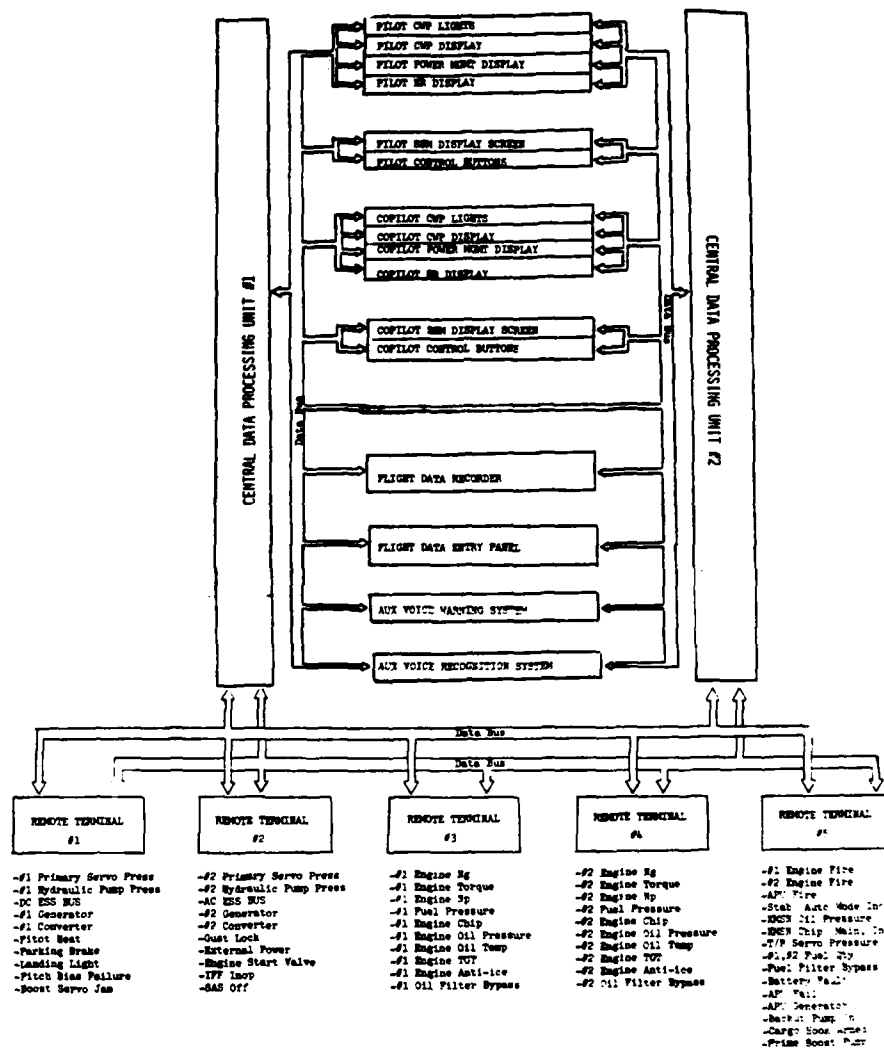


Figure 35. Long-term design architecture.

### Auxiliary Voice Warning System (VWS)

An auxiliary VWS has been included as a unit in the long-term design. This unit would transmit prioritized voice warning messages by means of computerized voice synthesis. The VWS is suggested as auxiliary to the CWP display. It is envisioned that when experimental and simulation studies have determined the basic requirements for a synthesized VWS and have approved technology candidates, voice warning may serve as the primary system.

### Auxiliary Voice Recognition System (VRS)

The VRS is a computerized system that recognizes and understands human speech and performs verbally commanded functions. Within the SSM, the VRS would follow verbal commands to reset CWP lights, display Main SSM display information, accept FDEP data inputs, and display commanded checklists and performance information. It is envisioned that the VRS could also interact with other aircraft controls to be determined in the future.

There is in fact no requirement in the SSM as designed for the pilot or copilot to employ manual controls, since the system functions automatically to monitor and display all essential information. The additionally included SSM display buttons and FDEP keyboard, which are intended for optional use during low workload conditions, do entail manipulation. Since current helicopter flight controls require use of both hands, any system that eliminates manual workload under any conditions is of potential value. The applications of the VRS to the SSM are therefore useful but limited, and the true value of a VRS must await design, experimental, and simulation studies determining the possible applications of a VRS to other control functions and the adequacy of VRS technology in addressing those applications.

### SUMMARY OF SSM UNIT FUNCTIONS

Each of the designs described above includes displays that replace existing subsystem displays. The SSM is not intended as an auxiliary system, but rather as the primary system for monitoring and displaying the status of aircraft subsystems in a manner that reduces crew workload and enhances mission effectiveness, especially during high workload NOE flight.

The listing which follows identifies the units defined in the designs described above, and outlines their functions.

#### REMOTE TERMINAL (RT)

- SENSOR INFORMATION GATHERING
- ANALOG TO DIGITAL CONVERSION
- DIGITIZED DATA STORAGE
- SENSOR FAILURE ANALYSIS
- BIT AS COMMANDED BY CDPU

## **CENTRAL DATA PROCESSING UNIT (CDPU)**

- DIGITIZED SENSOR DATA PROCESSING**
- SENSOR DATA COMPARISON TO PRE-ESTABLISHED LIMITS**
- PROVIDE BIT COMMANDS TO RT'S**
- PROVIDE COMPUTATION CAPABILITY**
- SUPPLY DATA TO FDR**
- PERFORM SELF-BIT FUNCTIONS**
- PROVIDE LOGIC FOR PRIORITIZED DISPLAYS**
- PROVIDE SYMBOL GENERATION FOR DISPLAYS**
- PROVIDE DATA, LOGIC, AND SYNCHRONY FOR DISPLAYS AND CONTROLS**
- STORE AND PROVIDE DATA AND LOGIC FOR FDEP**

## **DISPLAYS**

- PRESENT CAUTION, WARNING, PRECAUTION, AND ADVISORY MESSAGES AND DATA AUTOMATICALLY**
- PRESENT SUBSYSTEM STATUS INFORMATION WHEN COMMANDED MANUALLY**
- PRESENT EMERGENCY PROCEDURES WHEN COMMANDED MANUALLY**
- PRESENT FDEP COMMANDS AND DATA WHEN COMMANDED MANUALLY**

## **FLIGHT DATA ENTRY PANEL (FDEP)**

- COMMAND PERIPHERAL FUNCTION DISPLAYS**
- INPUT PERIPHERAL FUNCTION DATA**

## **FLIGHT DATA RECORDER (FDR)**

- RECORD STATUS OF RELATED PARAMETERS DURING OVER/UNDER LIMIT CONDITIONS**
- RECORD SENSOR FAILURES**

## **AUXILIARY VOICE WARNING SYSTEM (VWS)**

- PROVIDE SYNTHESIZED VOICE WARNING AND CAUTION MESSAGES**

## **AUXILIARY VOICE RECOGNITION SYSTEM (VRS)**

- INTERPRET HUMAN SPEECH AND COMMAND CDPU TO DISPLAY REQUESTED DATA**

## **SCHEMATIZATION OF SYSTEM LOGIC**

A block diagram of the Subsystem Status Monitor is presented in Figure 36. Figure 37 illustrates Warning/Caution light logic. Figure 38 illustrates CWP Display logic. Figure 39 illustrates Power Management Display logic. Figure 40 illustrates NR Display logic. Figure 41 illustrates rate sensing logic for the Precaution light. Figure 42 illustrates the Main SSM Screen logic. Figure 43 illustrates fuel monitoring logic. Figure 44 illustrates the logic of the Flight Data Recorder. Figure 45 illustrates the logic governing internal system testing.

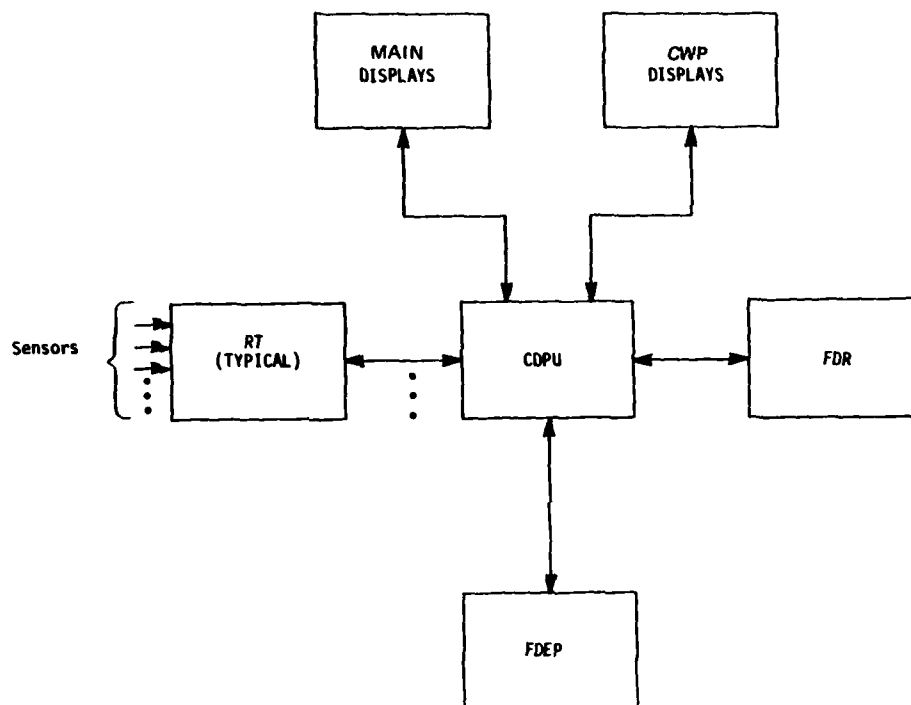


Figure 36. Subsystem Status Monitor block diagram.

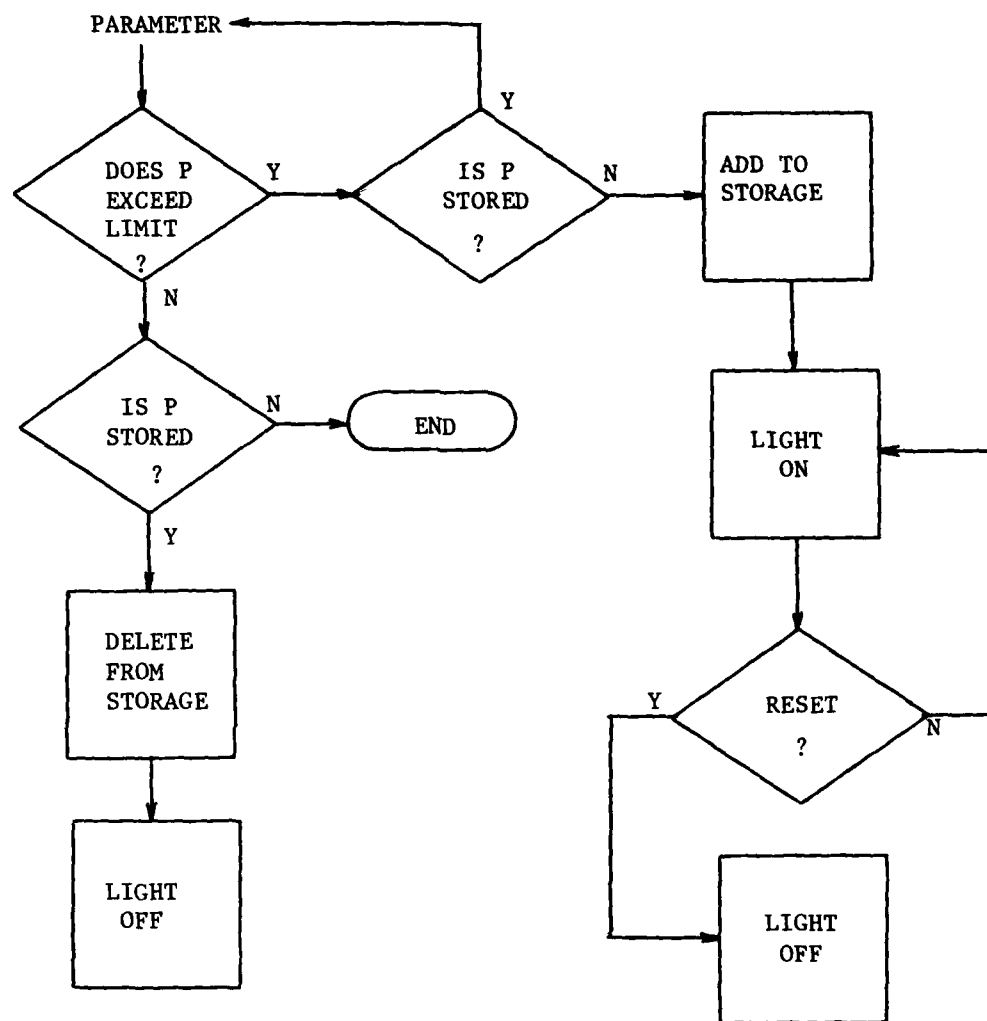


Figure 37. Warning/Caution light logic.

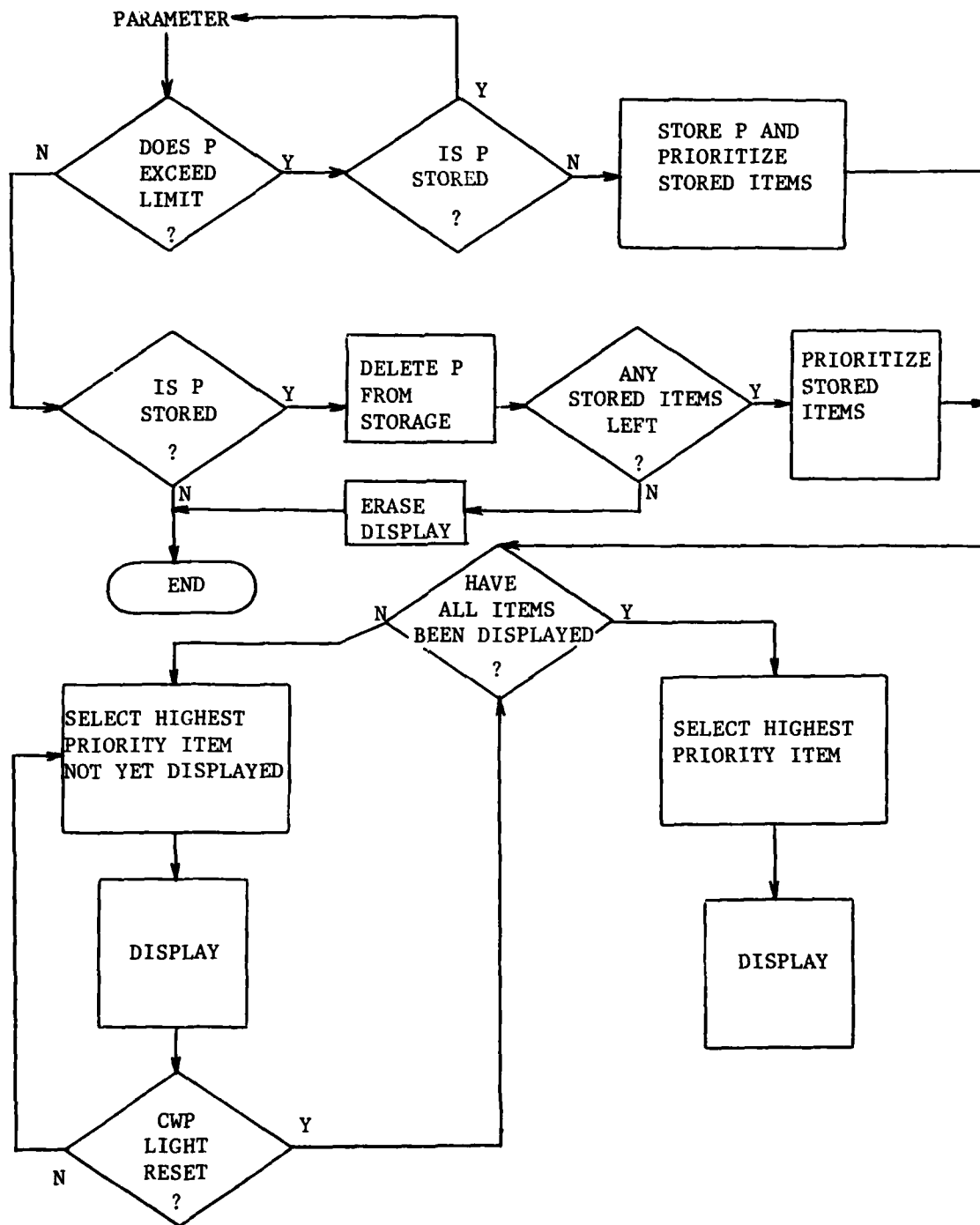


Figure 38. CWP Display logic.

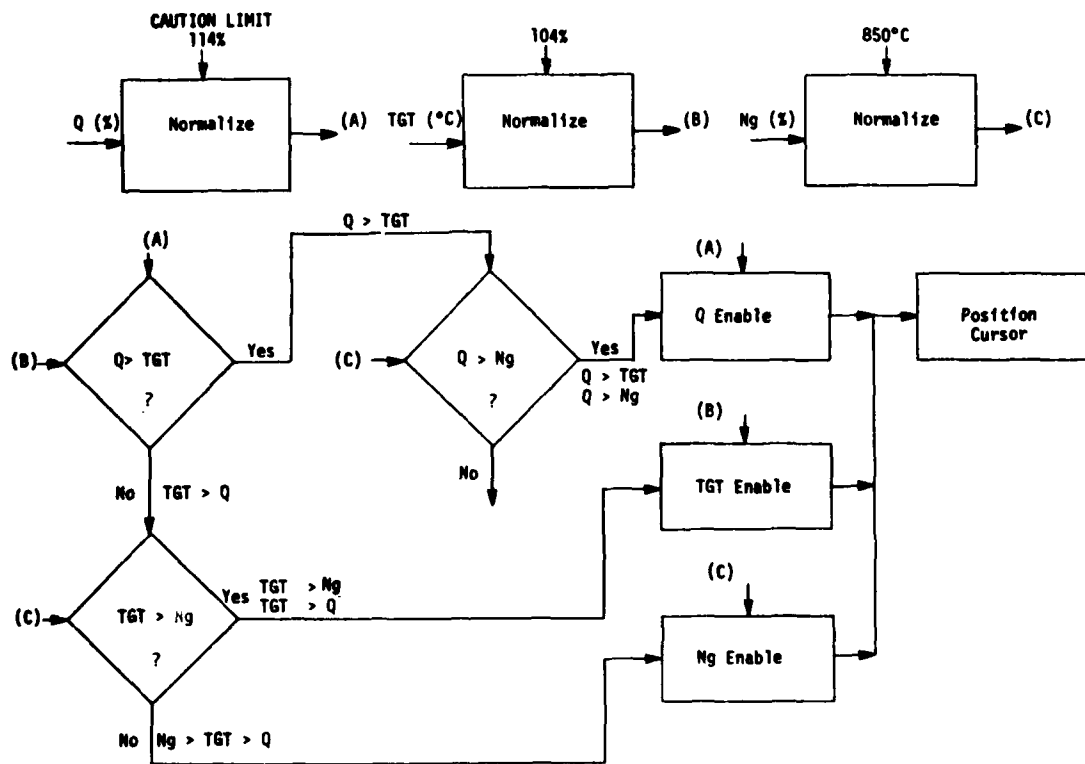


Figure 39. Power Management Display logic.



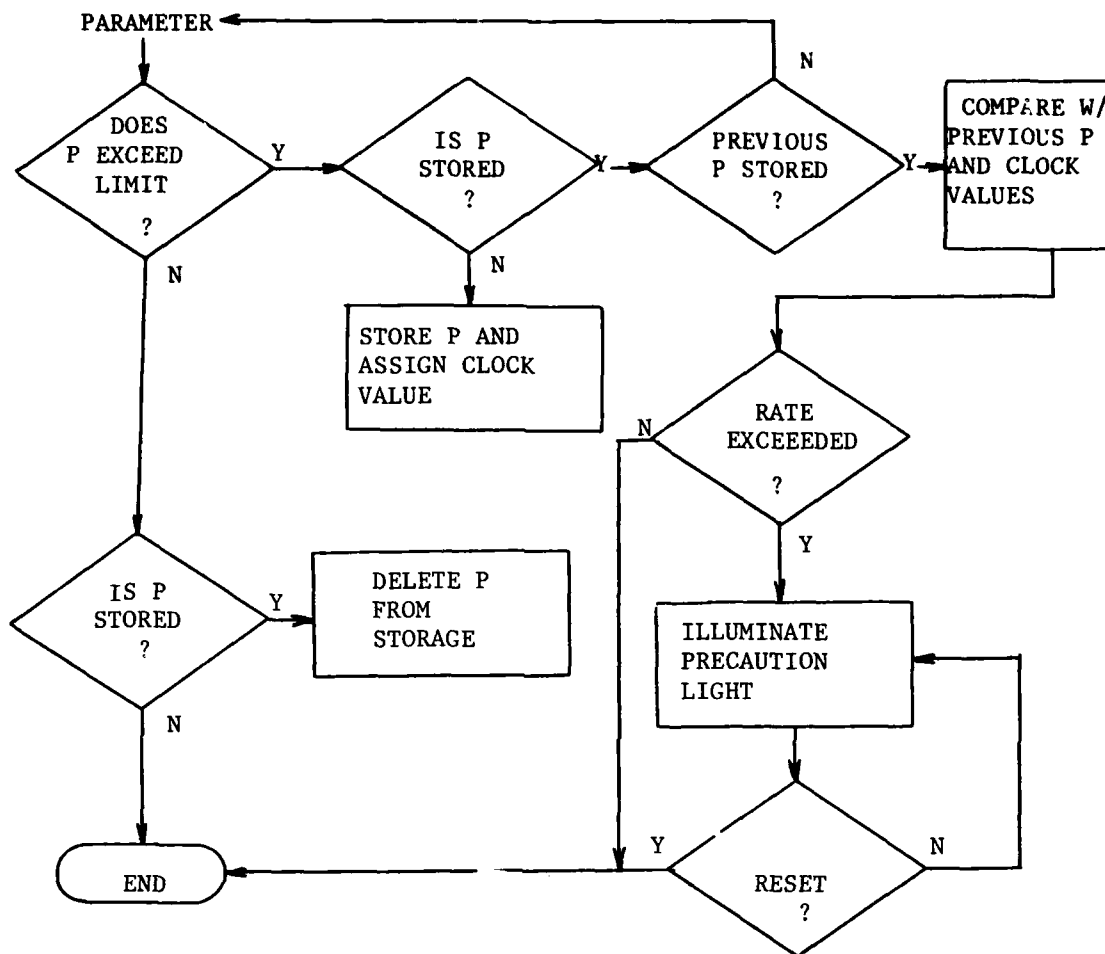


Figure 41. Precaution light logic.

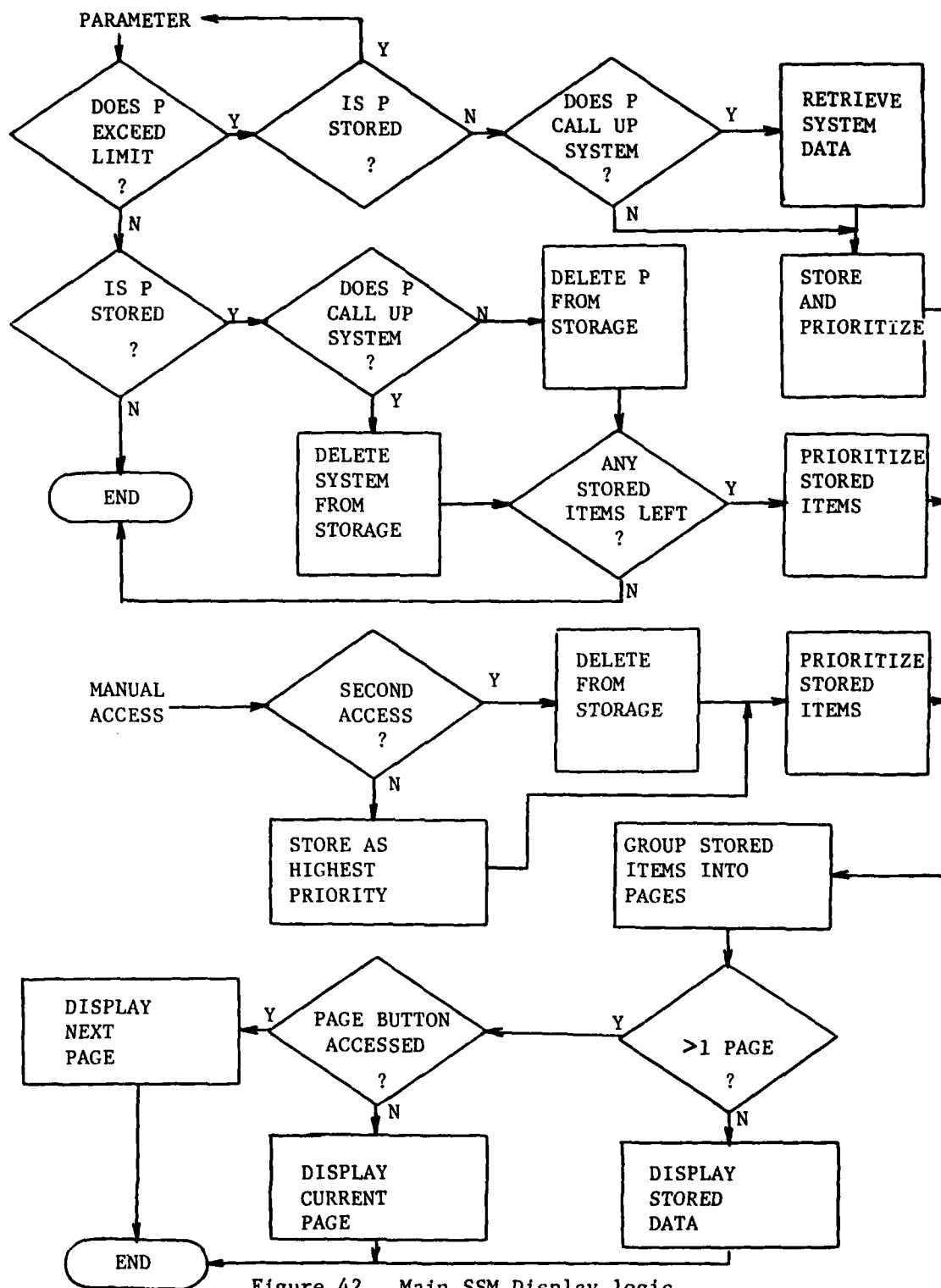


Figure 42. Main SSM Display logic.

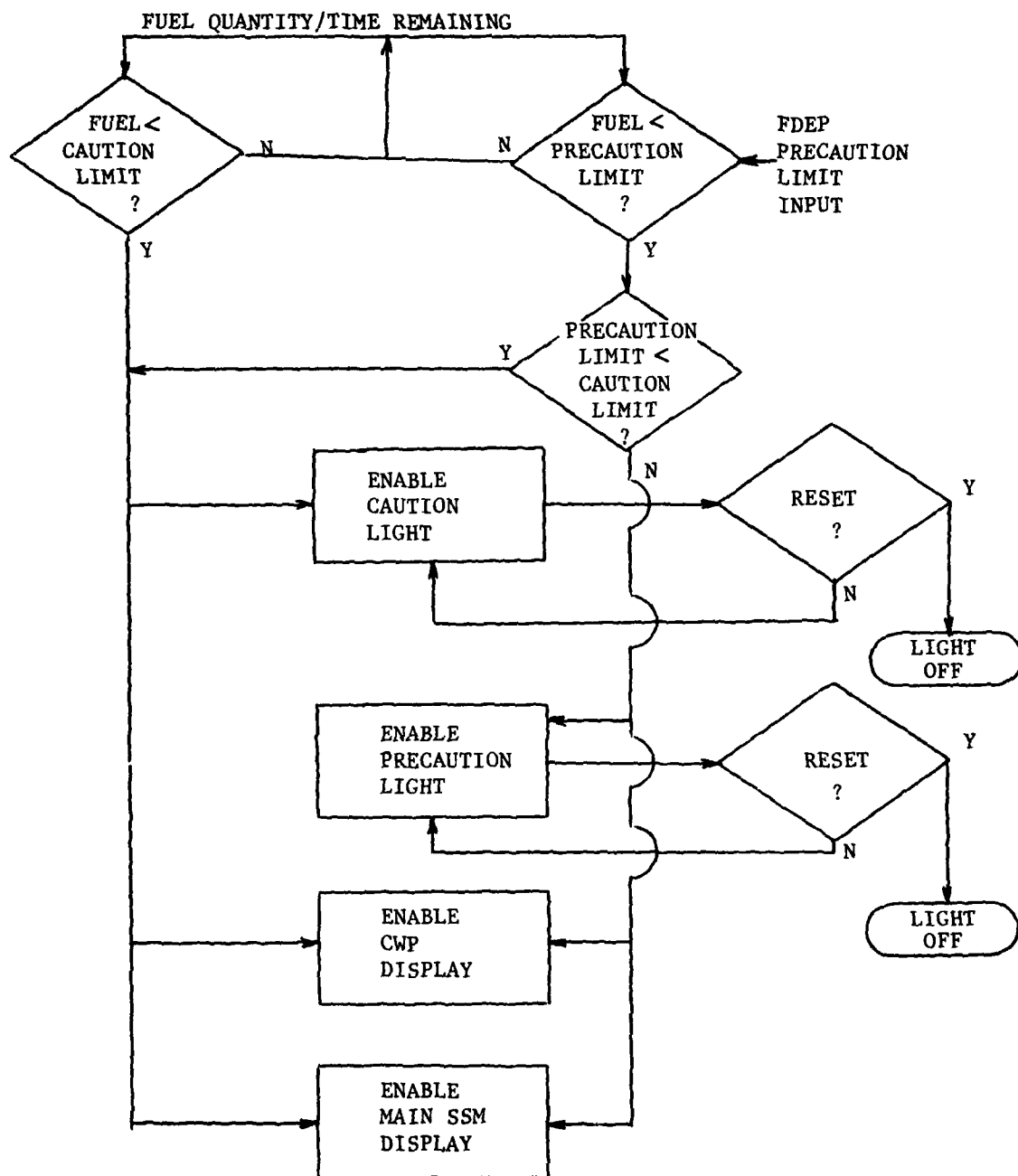


Figure 43. FUEL LOW logic.

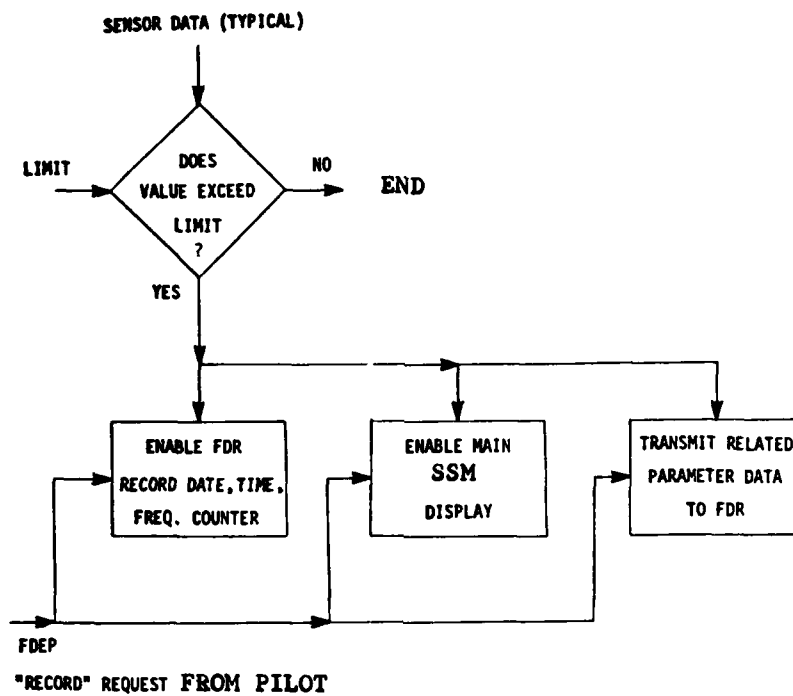


Figure 44. Flight Data Recorder logic.

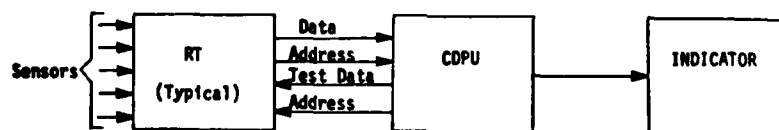


Figure 45. Internal system testing logic.

#### TASK IV: EVALUATION OF DESIGNS

The preliminary designs developed during Task III were submitted for evaluative review to specialists in the areas of: flight safety; crew workload; aircraft space, volume, and weight; reliability and maintainability; survivability and vulnerability; and life cycle cost estimation. Summaries of these evaluations follow.

##### FLIGHT SAFETY

The following points were highlighted during flight safety evaluation:

1. The CWP display will greatly enhance out-of-cockpit visual attention during NOE flight.
2. If collimation of the CWP display could be achieved, the resulting removal of the requirement to refocus night vision goggles would enhance flight safety, especially during NOE flight.
3. The capability of performing sensor failure analysis in advance of message display is likely to considerably enhance flight safety by reducing the frequency of falsely aborted missions.
4. The greatest advantages of the SSM appear during workload extremes. Under high workload flight conditions, in-cockpit eye time is reduced; under low workload conditions, peripheral functions may be utilized.
5. Though performed independently, evaluations of reliability, maintainability, and survivability/vulnerability will impact flight safety considerations.
6. Finalized flight safety evaluation would benefit from experimental and in-flight evaluations of human performance. Human reliability testing of any eventual hardware is recommended.
7. Efficient training and relearning techniques will be an essential feature contributing to flight safety when an SSM is eventually put to applied use.

##### CREW WORKLOAD

A thorough workload analysis would require experimental investigation involving functional hardware, with provisions for measuring secondary task performance, physiological indices of stress and fatigue, and subjective evaluations of users. In the absence of hardware, the current workload analysis was rudimentary and limited to reexamination of task analyses and to evaluation of design features by comparison with workload reduction guidelines typically applied to evaluation of displays and display controls.

Task sequences for subsystem monitoring during a #1 ENGINE OIL PRESSURE LOW condition were compared for existing and SSM configurations. Under existing configurations, a crew member would be required to perform the following tasks:

1. Note caution light.
2. Press to reset.

3. Scan caution/advisory panel.
4. Identify condition.
5. Scan instruments.
6. Interpret #1 ENG OIL PSI value.
7. Intermittent repetition: steps 3,4,5,6.

For the same condition under the SSM configuration, the crew member would be required to:

1. Note caution light.
2. Read CWP screen.
3. Press to reset.
4. Intermittent repetition: step 2.

The SSM sequence is shorter than the existing sequence and improves by comparison over time, and steps 7 (existing) and 4 (SSM), which entail intermittent monitoring, are repeated. The comparison also improves in proportion to the amount of other required workload.

The UH-60A Operational Sequence Diagrams (OSD's) were reviewed and the number of different tasks performed by pilot and by copilot during each minute of a representative flight profile were tabulated. The OSD's listed subsystem monitoring as a discrete task, and it was counted as such in the tabulation. Minute-by-minute tabulation was reviewed and subsystem monitoring tasks were deleted, according to the following rationale: the existing system requires intermittent monitoring of instruments to determine whether parameters are approaching limits; the SSM does not, and the task may therefore be deleted. Figure 46 compares the number of tasks performed by pilot and copilot under existing and under SSM configurations for each minute of a three-leg flight profile that includes flight to pickup zone, flight to landing zone (including NOE), and return to base.

Figure 47 presents Figure 46 data as percentage of tasks reduced through employment of the SSM design. It will be noticed that every minute of the flight profile entails workload reduction by this analysis, and that at several points the copilot workload is reduced by 100%.

Table 41 in Appendix A lists salient features of the SSM which promise to reduce crew workload during the monitoring of helicopter subsystems. The matrix compares SSM features with workload elements. This analysis is conceptual, and each cell of the matrix is susceptible to further experimental analysis. The future conduct of such experimental evaluations is highly recommended during the development of any hardware for eventual applications.

#### SPACE, VOLUME, AND WEIGHT

The following points were highlighted during space and volume evaluations:

1. The replacement of current dedicated displays (dials, gages, and caution/advisory panel) by the multi-function SSM displays will result in a saving of instrument panel space.
2. The FDEP, VWS, and VRS will result in increased volume requirements within the cockpit.
3. The CDFU's, FDR, and RT's are likely to require additional volume,

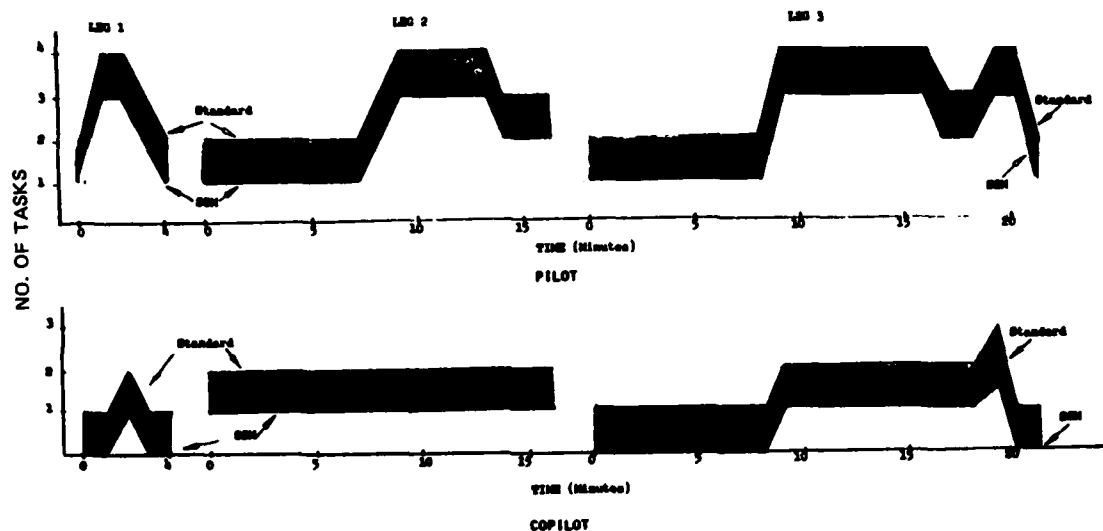


Figure 46. Flight profile comparison of existing (standard) vs. SSM configuration workload. Comparisons are based upon data from the UH-60A Operational Sequence Diagrams.

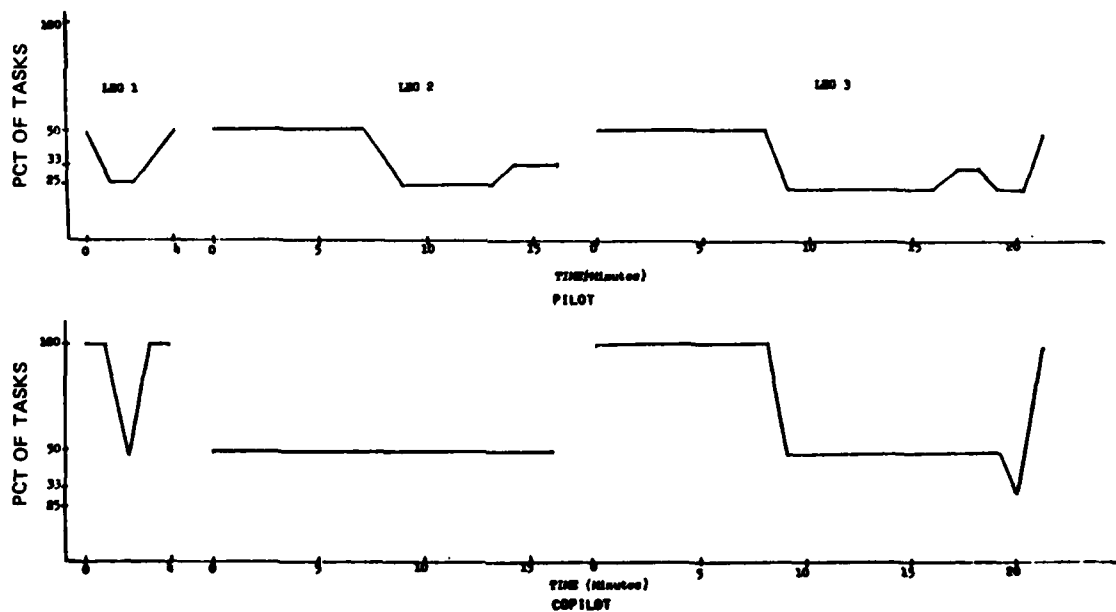


Figure 47. Percentage of tasks reduced through application of the SSM. Data based upon UH-60A Operational Sequence Diagrams.

though this will be offset to the extent that computer technology succeeds in achieving further miniaturization.

4. Designs including multiplexed data transmission will result in reduced wiring.

5. Center of gravity considerations will be important when designing for installment of any eventual hardware.

An estimate of the weight of each unit of each preliminary design was made. The weight of each existing unit in each helicopter that would be replaced by the SSM units was also estimated. Insofar as the CDPUs are not likely to be restricted to SSM usage, their weights were not included in the evaluation. Estimated weights of units replaced were subtracted from estimated weights of SSM units to be installed for each helicopter and for each preliminary design. The resulting delta estimates are presented in Table 42 in Appendix A.

Table 42 suggests that the weight analysis proves more favorable for the aircraft that currently include the greatest amount of instrumentation and wiring (UH-60A and CH-47C) and less favorable for the aircraft with less instrumentation and wiring (OH-58C and AH-1G). It should be noted that the weight estimates for SSM displays and RT's were conservatively based upon assumption of CRT's for the SSM main display and currently available RT technology. It may be fair to assume that technological development will provide either CRT's of reduced weight or feasible flat panel displays, and greatly reduced RT weights in the future. In this case, it may be predicted that the SSM will result in weight savings for both the UH-60A and the CH-47C for near-term and long-term designs. It should also be noted that the sharing of data transmission busses and/or displays by the SSM and other systems will result in reduced overall aircraft weight.

#### RELIABILITY AND MAINTAINABILITY

The following points were highlighted during reliability and maintainability evaluations:

1. The SSM designs result in fewer system components, a factor contributing to enhanced reliability.

2. The SSM designs involve considerable component derating, a factor contributing to enhanced reliability.

3. Component reliability is subject to change as near-term and long-term technology is developed. Given the factors of reduced number of system components and component derating, where SSM component reliability matches existing component reliability, overall reliability will be improved.

4. Extensive BIT capability will improve maintainability.

5. Modular construction will improve maintainability.

6. The data storage and analysis and growth capability of the FDR will result in improved maintainability.

7. The SSM is likely to permit standardization of parts across helicopter fleets. This parts standardization will greatly enhance maintainability.

## SURVIVABILITY/VULNERABILITY

The following points were highlighted during the survivability/vulnerability evaluation:

1. The redundancy of CDPU's and displays satisfies survivability requirements. For designs employing RT's, it is recommended that sensor inputs be conveyed to more than one RT per sensor.
2. The long-term design employing fiber-optics data transmission will result in significantly improved tolerance to both weaponry and electromagnetic interference.
3. Unit locations and shielding will have to be considered when any SSM is installed.

## LIFE CYCLE COSTS

Life cycle cost estimates were made for the UH-60A. Investment costs (development, production, and initial spares) and operating and support costs (fuel, preventive maintenance, unscheduled maintenance, and replenishment spares) were estimated and totaled for the existing design and for the near-term and long-term SSM designs. Totals for existing design were subtracted from totals for the SSM designs, yielding delta estimates. The resulting delta estimates for the UH-60A are presented in Table 43 in Appendix A, which assumes a fleet of approximately 1100 helicopters, and constant 1979 dollars. Estimates do not include the CDPU's, since it was assumed that the CDPU's will not be restricted to the SSM system.

Life cycle cost estimates must be qualified by the following considerations:

1. All life cycle cost estimates are necessarily rough, in the absence of well-defined hardware.
2. Operating and support costs were not driving factors in the results yielded. Rather, production and installation costs were the predicted driving factors. These production and installation estimates were based upon conservative expectations, and it must be hypothesized that actual production and installation costs will be lower than estimated.
3. Since production and installation costs are the predicted driving factors, any standardization of units across fleets of different types of helicopters will result in considerable reduction of life cycle costs, a factor not input into the current evaluation.
4. In the absence of experimental data, no attempt was made to include improvements in mission effectiveness achievable through the SSM in the current analysis of life cycle costs. A thorough treatment of the life cycle costs presented must include consideration of any improvements in mission effectiveness achieved through workload reduction, inclusion of peripheral functions, and potential contribution to an integrated advanced cockpit.
5. It is predicted that weight and complexity factors will favor the UH-60A and the CH-47C to a greater extent than the OH-58C and the AH-1G, and life cycle cost estimates are likely to prove more favorable for the UH-60A and CH-47C than for the OH-58C or AH-1G.

#### SUMMARY OF ADVANTAGES AND DISADVANTAGES

The following major advantages of the SSM were identified during the evaluations of the SSM designs: crew workload reduction; flight safety enhancement; reduction in instrument panel space requirements; improved reliability and maintainability through component derating, use of fewer components, sensor failure analysis, internal system testing, flight data recording, and standardization of parts across fleets; simplified reconfiguration; addition of peripheral functions; growth capacity; and potential integration with other display and control systems.

Both life cycle cost and weight estimates were made upon conservative expectations of near-term and long-term technological progress. Based upon these conservative expectations, both life cycle cost and weight deltas were generally positive, but favored the UH-60A and CH-47C over the AH-1G and OH-58C. Before categorizing the life cycle cost and weight factors as disadvantages, the qualifications attached to these evaluations and presented in the discussions above should be considered.

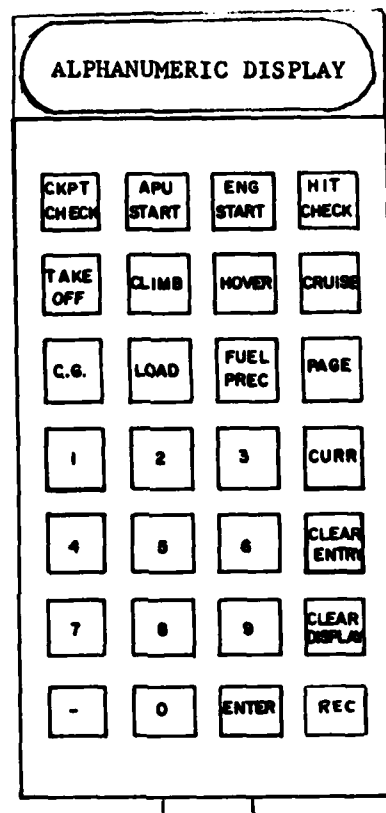
#### TASK V: IDENTIFICATION OF PERIPHERAL FUNCTIONS

During Task V peripheral functions which might be performed by the SSM were identified, a Flight Data Entry Panel (FDEP) for data input and display access of peripheral functions was designed, and formats for the display of peripheral information were defined.

Figure 48 illustrates the Flight Data Entry Panel designed. Approximating a hand-held calculator in dimensions, the FDEP is designed as a stowable keyboard for the input of performance data and the access of peripheral function displays, which will appear on the SSM main display. The FDEP operates either independently of the main SSM display for pre-flight calculations in the briefing room, or in conjunction with the main SSM display through an umbilical cord in the aircraft. When acting independently of the main system, the FDEP is self-powered and programmable for Technical Manual calculations. When connected to the main system, the stored calculations and data in the CDPUs are updated by the programmed FDEP inputs. Operation of the keyboard during flight will be described in connection with associated peripheral displays.

The top row of keyboard buttons are used to access checklists which are displayed on the main SSM screen. Depression of the CKPT CHECK button calls up the display of a cockpit checklist illustrated in Figure 49. Depression of the APU START button calls up the APU start checklist illustrated in Figure 50. Depression of the ENG START button calls up the Engine Start checklist illustrated in Figure 51. The Before Takeoff checklist illustrated in Figure 52 is an appendix to the Engine Start checklist and automatically appears at the end of the Engine Start checklist. Depression of the HIT CHECK button calls up the Hit Check display illustrated in Figure 53. The Hit Check display combines command statements (e.g., "Establish 60% Torque") with TGT status indications derived from comparison of TGT sensor inputs against stored limits. Taken together, the checklist buttons and displays replace the analogous portions of the Technical and Flight Operator's manuals.

The second row of buttons on the FDEP accesses performance calculation displays on the SSM main screen. All performance calculation displays require data input through the FDEP. Display formats distinguish between input data and resulting information by the size of letters and by an input prompt. In the case of the Takeoff performance calculation, whose display is illustrated in Figure 54 and accessed by depression of the TAKEOFF button, Pressure Altitude, FAT, and Gross Weight require data inputs. Each would be succeeded by a prompt character on the screen until data is input. Crew members may base performance calculations upon either currently sensed or predicted variables. If the crew member desires to input data which is currently sensed or which has been previously stored, he may do so by simply depressing the CURR button. If, for example, the crew member wished to input "current pressure altitude" as a basis for performance calculation, and the current pressure altitude were 2000 ft., then a depression of the CURR button would result in an input of 2000 ft. for pressure altitude and a display of 2000 ft. pressure altitude. If the crew member desires to input data which is not currently sensed or previously stored, he would respond to the input prompt by depressing



UMBILICAL CORD  
TO SSM MAIN DISPLAY

Figure 48. Stowable Flight Data Entry Panel.

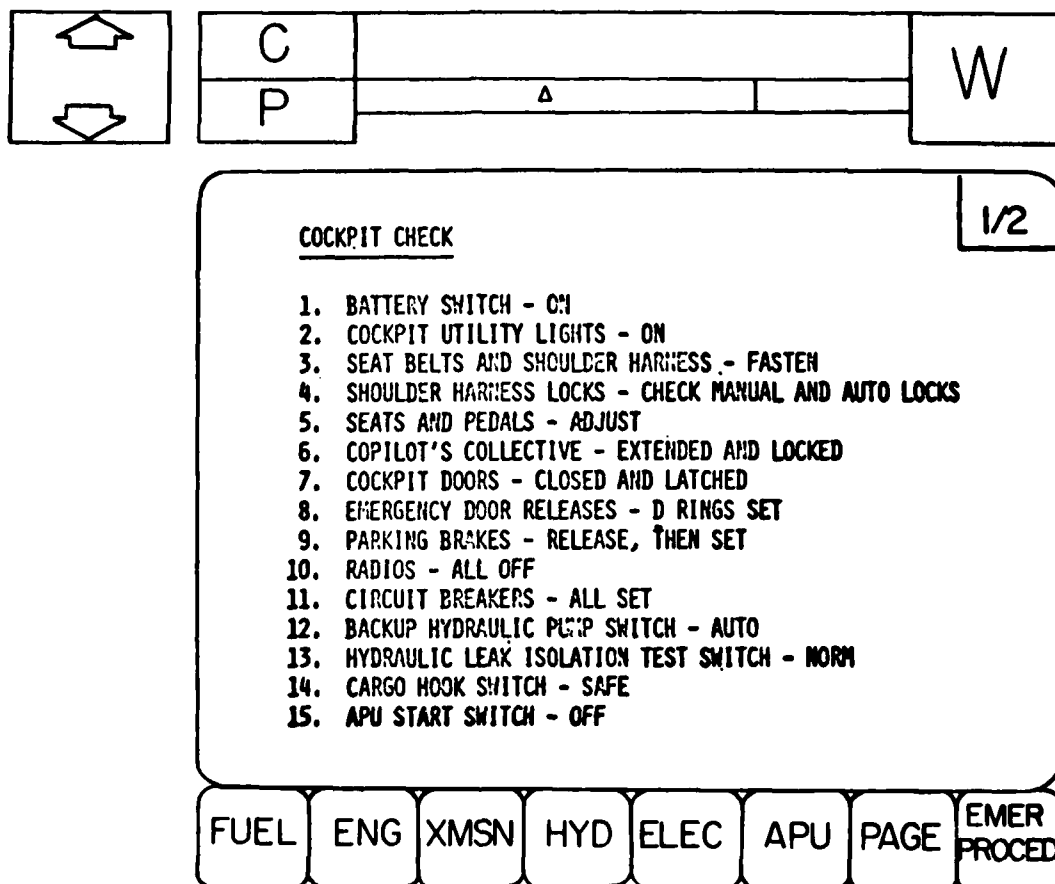


Figure 49. Cockpit Check display.

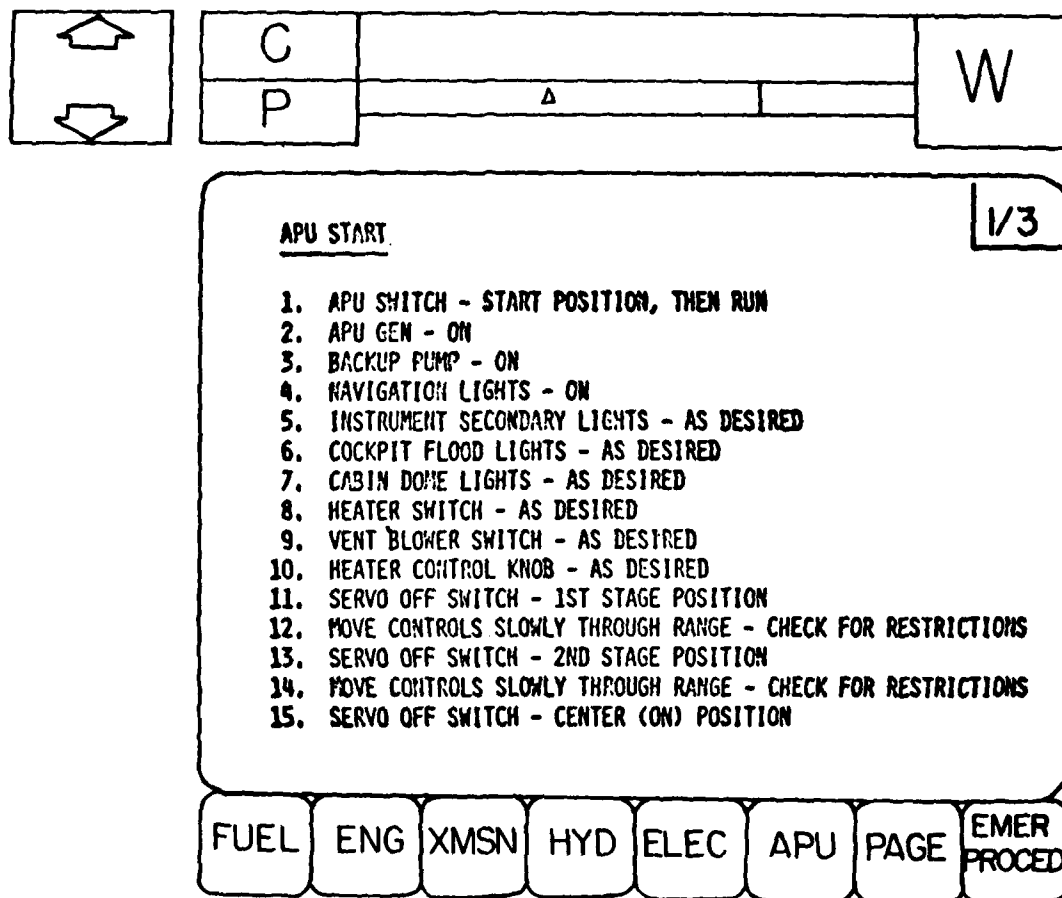


Figure 50. APU Start display.

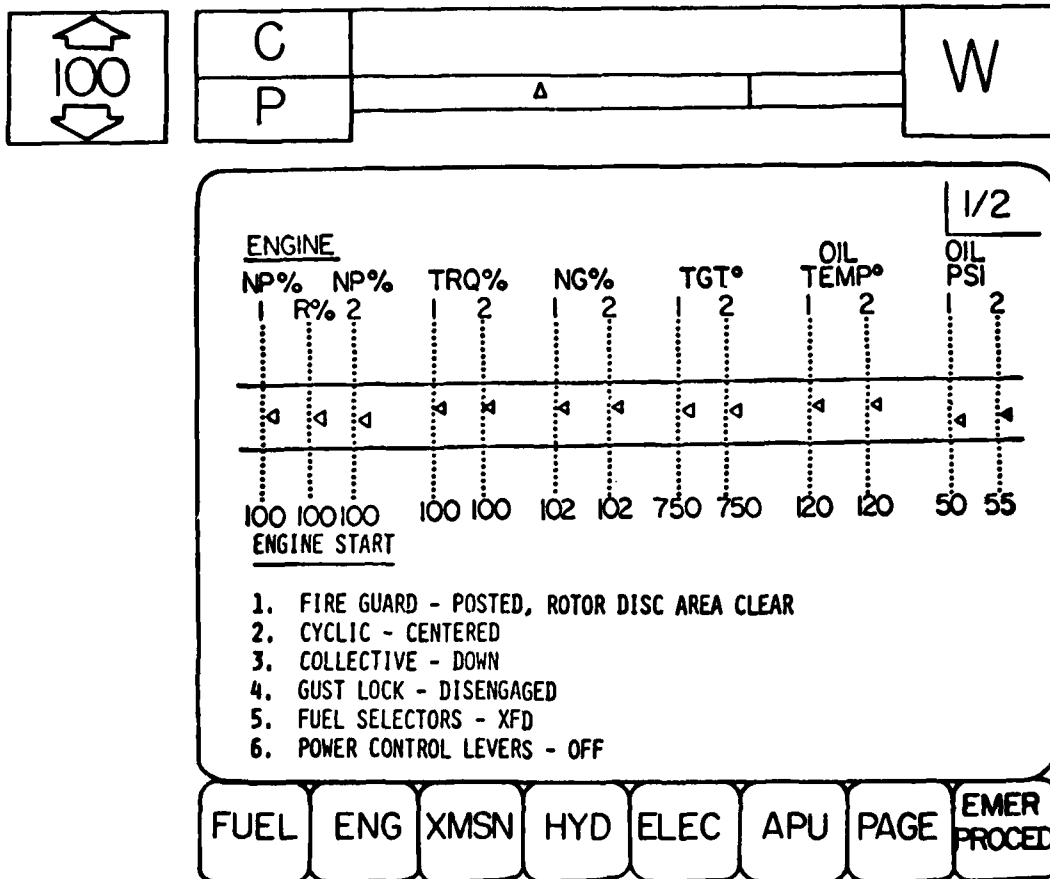


Figure 51. Engine Start display.

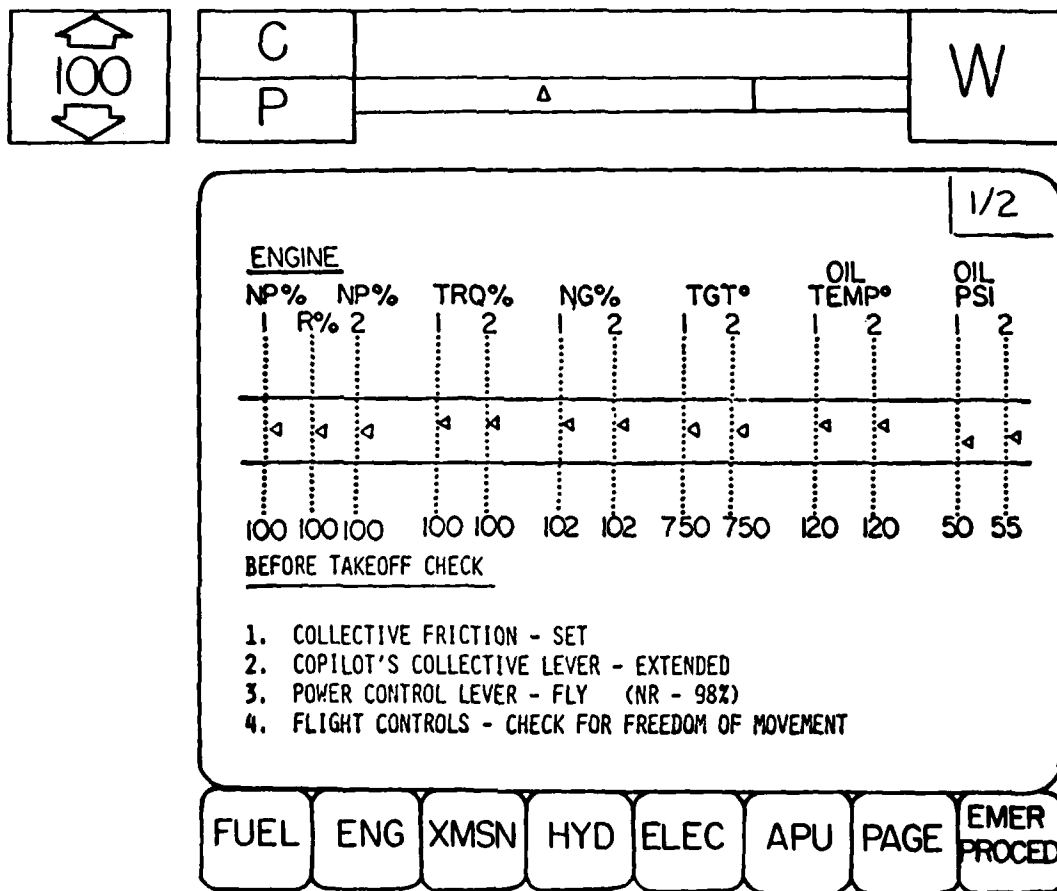


Figure 52. Before Takeoff Check display.

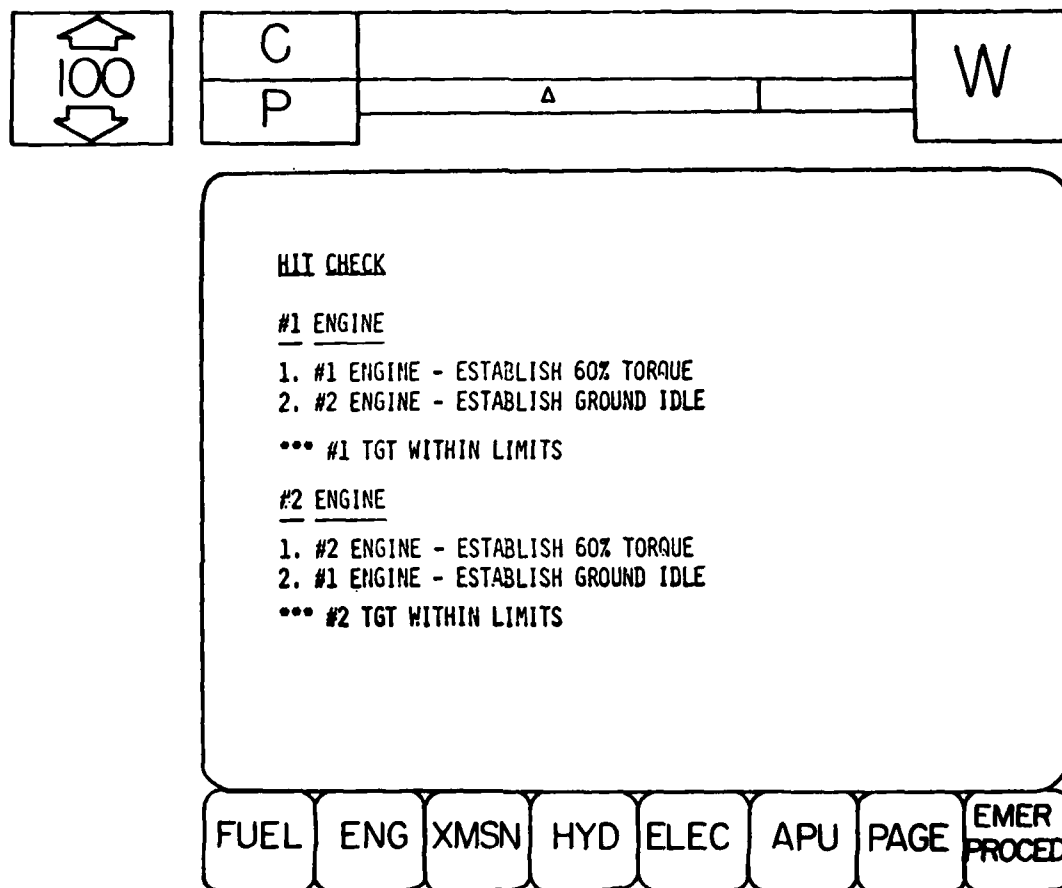


Figure 53. Hit Check display.

100

|   |          |   |
|---|----------|---|
| C |          | W |
| P | $\Delta$ |   |

TAKEOFF

|                      |                |
|----------------------|----------------|
| PRESSURE ALTITUDE    | 2000 FT        |
| FAT                  | +30 C          |
| GROSS WEIGHT         | 18000 LBS      |
| MAX GROSS WEIGHT     | 19400 LBS      |
| IAS                  | 23 KTS         |
| ACCEL DIST           | 150 FT         |
| CLEAR 50 FT          | 930 FT         |
| MAX TORQUE AVAILABLE | 94 % (INT PWR) |
| MAX TORQUE AVAILABLE | 74 % (MAX PWR) |

FUEL

ENG

XMSN

HYD

ELEC

APU

PAGE

EMER  
PROCED

Figure 54. Takeoff performance calculations.

the appropriate digit buttons. When the input is correct and complete, depression of the ENTER button enters the input data. Depression of the CLEAR ENTRY button erases from memory and display the last digit appearing on the display. In the case of the Takeoff display illustrated in Figure 54, the items from Max Gross Weight through Max Torque Available have been automatically calculated on the basis of the data input and the performance calculation information and algorithms stored in memory. Depression of the CLIMB button calls up the Climb display illustrated in Figure 55. Depression of the HOVER button calls up the Hover display illustrated in Figure 56. Depression of the CRUISE button calls up the Cruise display illustrated in Figure 57. Taken together, the performance calculation displays and inputs replace the performance calculation workload currently required in referencing the analogous portions of the Flight Operator's Manuals. It is believed that the flight phase and CURR input features of the FDEP represent novel contributions to the state of the art of performance calculation panels.

Depression of the C.G. button calls up the CG display illustrated in Figure 58. The CG display provides a qualitative indication of the relation between current center of gravity and forward and aft limits, as well as digital readouts of current CG, forward limit, and aft limit.

Depression of the LOAD button calls up the Hook Load display illustrated in Figure 59. The Hook Load display provides a qualitative indication of the hook loads for two cargo hooks (FWD and AFT) by reference to limits, and a digital readout of load in pounds for each hook.


Depression of the FUEL PREC button calls up a display of the current setting of the fuel precaution limit. The limit may be reset by depression of the digital keys, followed by depression of the ENTER button. The fuel precaution limit may be set higher or lower than the caution limit. As illustrated in the fuel logic diagram in Figure 43, when the precaution limit has been set higher than the caution limit a precaution condition will trigger the precaution light, and when the precaution limit has been set lower than the caution limit a precaution condition will trigger the caution light.

When the FDEP is in use and the SSM main screen indicates that information to be displayed exceeds screen capacity, paging may be accomplished by depression of the PAGE button on the FDEP.

FDEP accessed displays will automatically be relegated to a priority lower than that of caution, warning, precaution or advisory information and lower than the displays accessed by depression of the system buttons associated with the SSM main screen. The REC button activates the FDR. A second depression of the button deactivates the recorder unless an automatic actuation of the FDR has been commanded by the CDPUs.

#### ACCESS OF EMERGENCY PROCEDURES

Interviews with instructor pilots at Ft. Rucker, Alabama, confirmed the desirability of providing optional access to display of emergency procedures. While pilots insisted that emergency procedures should not be displayed automatically in conjunction with caution or warning messages since this would impose additional workload when displays were



C

Δ

W

CLIMB

|                      |          |           |
|----------------------|----------|-----------|
| PRESSURE ALTITUDE    | 2000     | FT        |
| FAT                  | +35      | C         |
| GROSS WEIGHT         | 18000    | LBS       |
| BEST IAS             | 80 KTS   | (INT PWR) |
| BEST ROC             | 380 FPM  | (INT PWR) |
| BEST IAS             | 80 KTS   | (MAX PWR) |
| BEST ROC             | 1378 FPM | (MAX PWR) |
| MAX TORQUE AVAILABLE | 90 %     | (INT PWR) |
| MAX TORQUE AVAILABLE | 70 %     | (MAX PWR) |

FUEL

ENG

XMSN

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EMER  
PROCED

Figure 55. Climb performance calculations.



C

W

P

Δ

HOVER

|                       |           |
|-----------------------|-----------|
| PRESSURE ALTITUDE     | 2000 FT   |
| FAT                   | +30 C     |
| FUEL                  | 800 LBS   |
| NR                    | 98 %      |
| HIGE MAX GROSS WEIGHT | 21000 LBS |
| HOGE MAX GROSS WEIGHT | 19200 LBS |
| HOVER ENDURANCE       | 0:42 MINS |

FUEL

ENG

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EMER  
PROCED

Figure 56. Hover performance calculations.

100

C

W

P

$\Delta$

CRUISE

|                   |            |
|-------------------|------------|
| PRESSURE ALTITUDE | 5000 FT    |
| FAT               | +30 C      |
| GROSS WEIGHT      | 18000 LBS  |
| AT NP             | 98 %       |
| AT TRQ            | 100 %      |
| FUEL FLOW         | 670 LBS/HR |
| MAX RANGE         | 450 MILES  |
| IAS               | 80 KTS     |
| TAS               | 110 KTS    |

FUEL

ENG

XMSN

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EMER  
PROCEED

Figure 57. Cruise performance calculations.

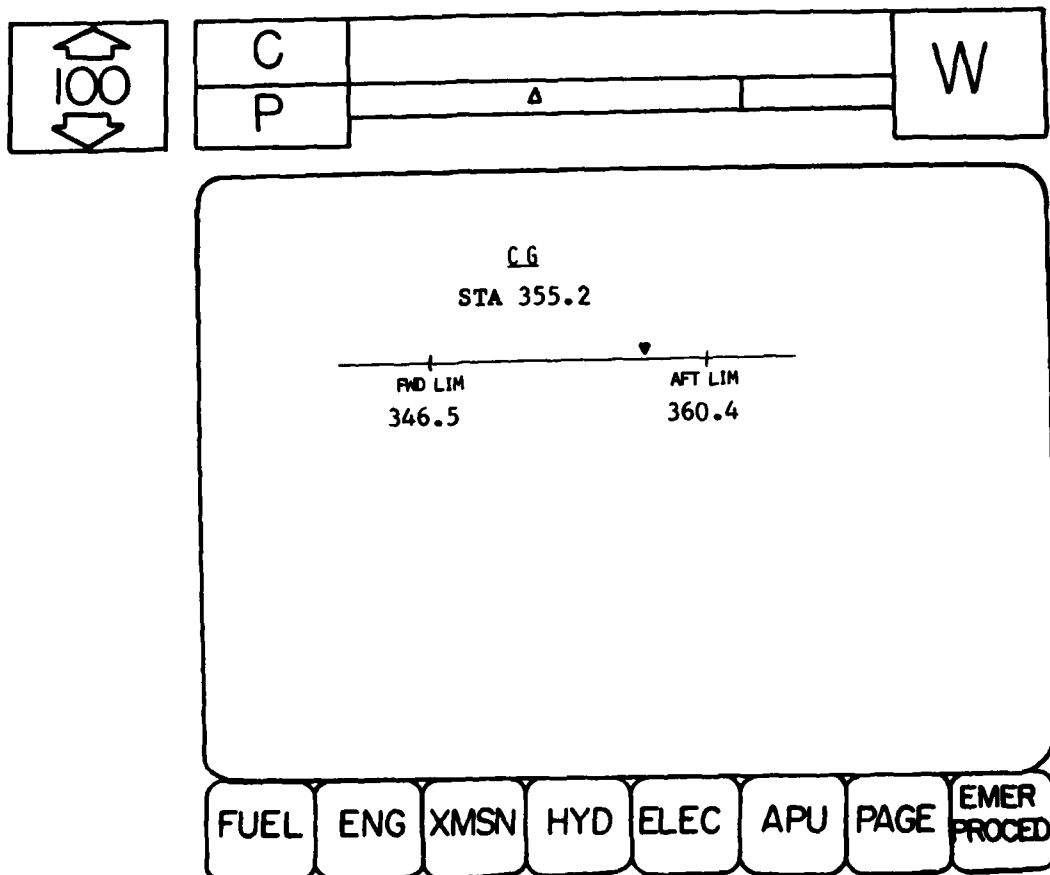


Figure 58. Center of Gravity display.

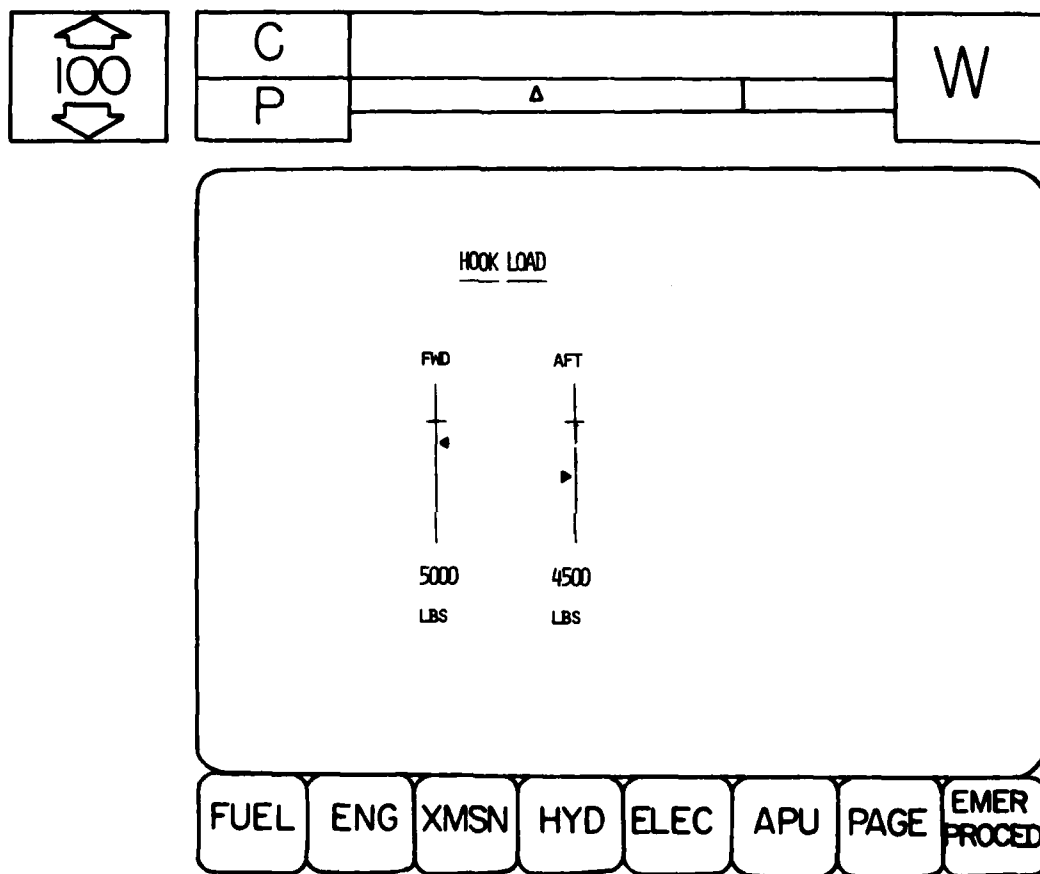


Figure 59. Hook Load display.

unnecessary, they did recommend ready access to any display controls for manual callup of emergency procedures. On this account, emergency procedures display access was not included in the FDEP, but was instead designed into the button row associated directly with the SSM main display. Figure 60 illustrates a sample Emergency Procedures display, accessed by depression of the EMER PROCED button. At any given moment, there are two subsets of emergency procedures: those associated with parameters currently out of tolerance, and those associated with parameters that are not currently out of tolerance. Crew members are more likely to desire access to emergency procedures associated with parameters which are out of tolerance. A single depression of the EMER PROCED button accesses automatically the emergency procedures associated with parameters currently out of tolerance. These parameters are prioritized, and the associated emergency procedures are displayed in prioritized fashion, until screen capacity is exceeded. Where paging is required, it is accomplished by depression of the PAGE button. A second depression of the EMER PROCED button clears the display of emergency procedures. Depression of a system button (FUEL, ENG, etc.,) immediately following depression of the EMER PROCED button will erase display of emergency procedures associated with out-of-tolerance parameters and switch mode to display emergency procedures for all parameters associated with the accessed system, in order of parameter priority. Where required, paging is accomplished by depression of the PAGE button. A second depression of the EMER PROCED button erases the display of emergency procedures.

#### OTHER PERIPHERAL FUNCTIONS

Several peripheral functions associated with aircraft maintenance have been discussed under the Preliminary Designs section, including flight data recording and playback. Though not included in the design, the following possibilities for maintenance peripherals have been identified through interviews with maintenance personnel: utilization of SSM displays and computer memory storage for presentation of troubleshooting trees onboard the aircraft; storage of maintenance data onboard the aircraft, where it is anticipated that the aircraft will be maintained in different locations at different times ( while such storage might include time-line item replacement recording, it was not recommended that the aircraft serve as the sole storage location for maintenance data); and inclusion of provisions for integration of various additional sensors with the FDR for diagnostic testing.

The following peripheral applications to student flight training were identified: use of the FDR to record student responses to system events, and use of the CDPUs to program ground-based simulation exercises. In tandem aircraft, the SSM might be especially useful for instructor monitoring of student responses to system events through the SSM main screen and use of the main screen for student monitoring of instructor-provided prompts. It is anticipated that recording of student responses to system events will require additional sensors as well the use of the SSM display for instructor monitoring of student responses. It is also anticipated that allowing for instructor prompts, displayed to the student through the SSM main screen, will require an additional keyboard or console.

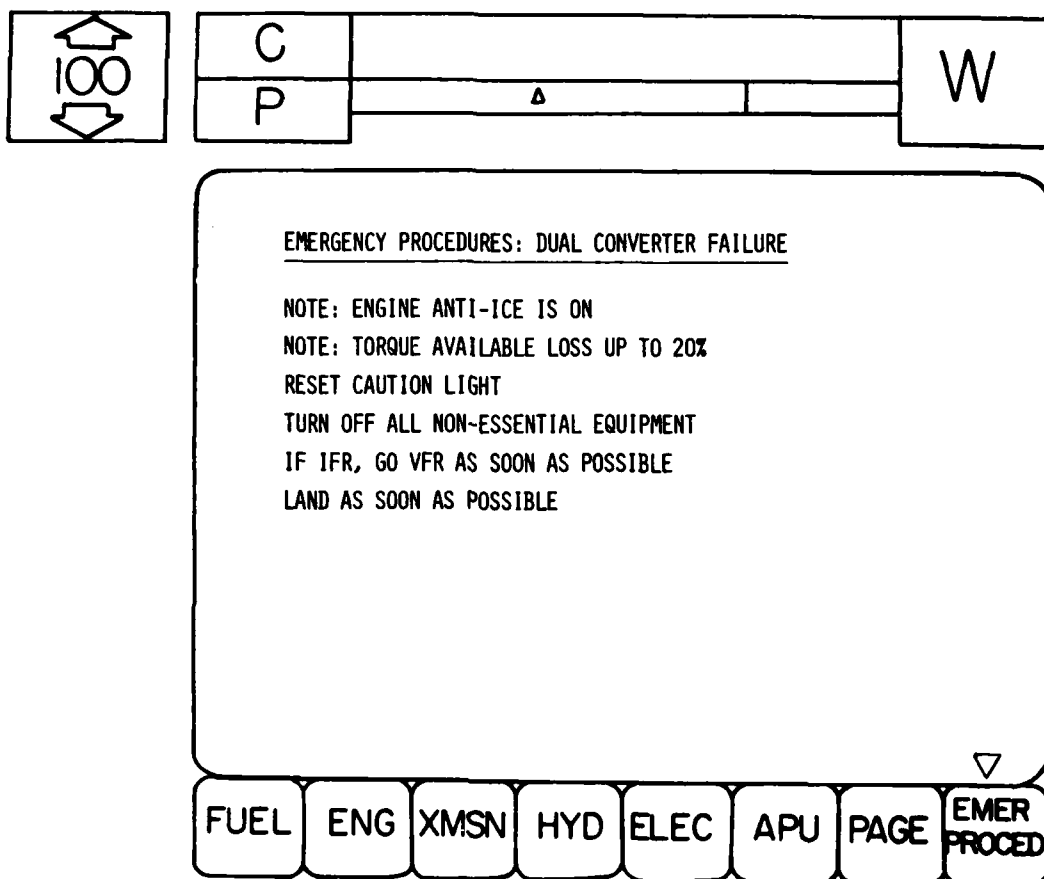


Figure 60. Emergency Procedures display.

In all cases the potential use of the SSM for training of student pilots highlights the flexibility inherent in the SSM design. This flexibility of programming feature will in general facilitate the following: inclusion of additional system models for improved sensor failure analysis and diagnostics, as they become available; inclusion of additional sensors as they become available, with allowances for easy reprioritization; alteration of emergency procedures, checklists, and performance calculation data bases and algorithms; redefinition of precaution, caution, and warning limits; inclusion of automated responses as they become available; reconfiguration of helicopters for different missions; and integration of the Subsystem Status Monitor with other systems under development within the framework of the Army's extensive efforts to design, test, and construct a reduced workload and more mission-effective helicopter cockpit.

## CONCLUSIONS AND RECOMMENDATIONS

The following general conclusions may be drawn from the foregoing report:

1. The display-by-exception philosophy currently governing the display of many subsystem parameters displayed via caution/warning panels in helicopters can be viably extended to include other subsystem parameters currently displayed via dedicated instruments. Exceptions to this rule are main rotor speed, which should be continually displayed, and power management parameters, which should be combined into a single power management analog indicator.
2. A separate logic governing the display of parameters under differing mission phases or environmental conditions is not required.
3. The advanced Subsystem Status Monitor (SSM) defined in the foregoing report will reduce crew workload, improve mission effectiveness, enhance reliability, maintainability, and survivability/vulnerability, permit standardization of parts across helicopter fleets, and accommodate subsystem growth and increasing complexity.
4. The impact of the SSM designs discussed upon life cycle costs and aircraft weight will be more favorable for aircraft of large weight and complexity in their subsystems.

The following general recommendations may be drawn from the foregoing report:

1. The display logic and formats discussed should be submitted to experimental evaluation to determine quantitatively their impact upon human performance and reliability before incorporation into any hardware applications based upon the designs presented.
2. While voice synthesis and recognition appear to represent long-term solutions to the problem of information input/output under NOE helicopter flight conditions requiring constant manual control of the helicopter and visual attention to the outside world, the topic of computerized voice interaction should be studied carefully to determine the most effective applications of this emerging technology.
3. Any hardware development of the SSM designs presented should be complemented by a repetition of reliability, maintainability, survivability/vulnerability, aircraft weight, life cycle costs, safety, and human workload/reliability evaluations.
4. The interaction of the SSM with other designs aimed at cockpit integration should be studied.

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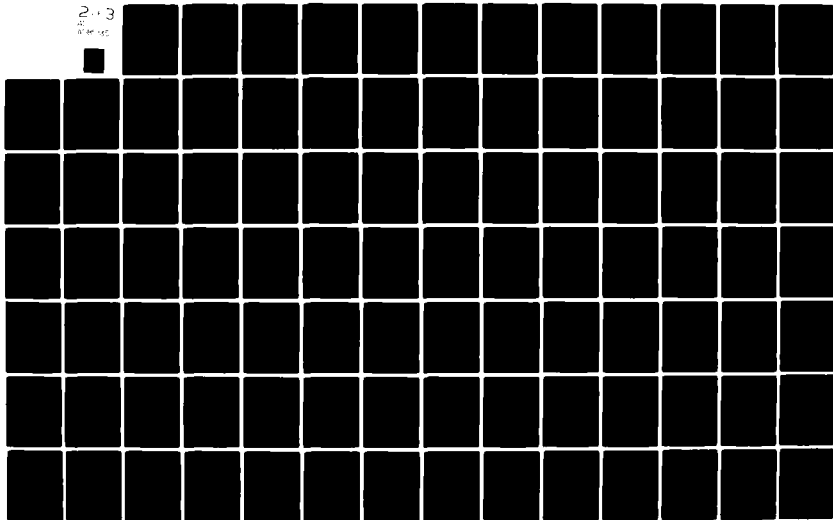
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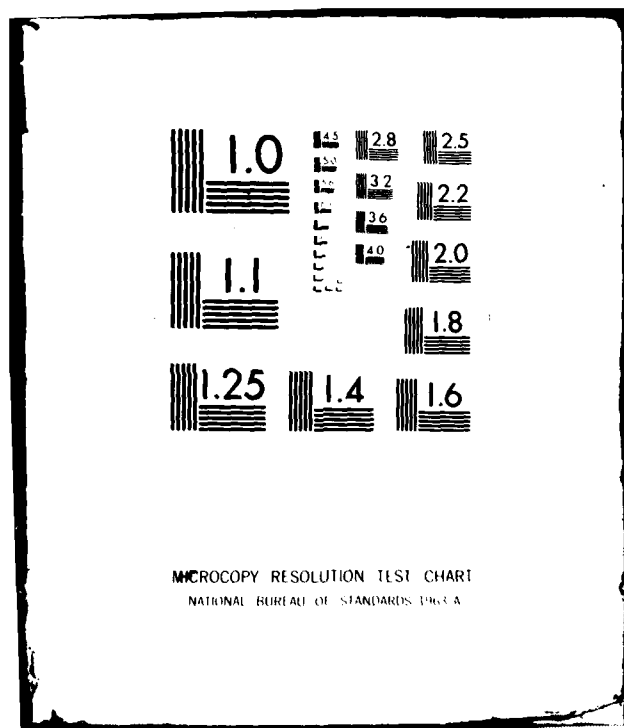
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#### APPENDIX A: TABLES 1-43

Tables 1-8 summarize subsystem parameters obtained from the UH-60A, CH-47C, OH-58C, and AH-1G operator's manuals. Tables 9-12 summarize cross-comparisons of UH-60A, CH-47C, and AH-1G parameters. Tables 13-16 present the results of an information requirements analysis. Tables 17-20 constitute the preliminary formatting of an information requirements questionnaire that was later submitted to Army pilots. Tables 21-24 present composite responses to the pilot questionnaire. Table 25 presents a cross-comparison of parameters by subsystem. Table 26 lists the major signal source devices used in the four helicopters studied. Tables 27-30 summarize the display logic for each helicopter. Tables 31-34 present data on automatic displays and multiple accessing. Tables 35-38 present prioritized listings of items of information for each helicopter. Table 39 shows the relationship of parameter groups. Table 40 compares the properties of data transmission cables. Tables 41 and 42 evaluate workload reduction and weight savings attributable to the SSM. Table 43 presents SSM life cycle cost estimates for the UH-60A.

TABLE 1. UH-60A PARAMETERS CURRENTLY DISPLAYED VIA ANALOG INSTRUMENTS.

| SUBSYSTEM       | PARAMETER         | RANGE      | NORMAL OP BAND | PRECAUTION LIMIT        | MAJUNCTION LIMITS             | INDICATOR        | SIGNAL SOURCE                | PARAMETER TYPE |
|-----------------|-------------------|------------|----------------|-------------------------|-------------------------------|------------------|------------------------------|----------------|
| FUEL 1          | FUEL QUANTITY 1   | 0-1500 LBS | 200-1500 LBS   | 0-200 LBS               | -                             | Vertical Scale   | Tank Unit                    | Analog         |
| FUEL 2          | FUEL QUANTITY 2   | 0-1500 LBS | 200-1500 LBS   | 0-200 LBS               | -                             | Vertical Scale   | Capacitance Probes           | Analog         |
| FUEL            | TOTAL FUEL        | 0-3000 LBS | 400-3000 LBS   | 0-400 LBS               | -                             | Vertical Scale   | Capacitance Probes           | Analog         |
| MAIN XMSN       | XMSN OIL PRESSURE | 0-190 PSI  | 35-65 PSI      | 25-35 PSI<br>65-130 PSI | Below 25 PSI<br>Above 130 PSI | Vertical Scale   | Variable Reluctance Sensor   | Analog         |
| MAIN XMSN       | XMSN OIL TEMP     | -50-160°C  | -50-120°C      | 120-140°C               | Above 140°C                   | Vertical Scale   | Temperature Sensor           | Analog         |
| ENGINE 1        | ENG 1 OIL TEMP    | -50-180°C  | 40-135°C       | 135-150°C               | Above 150°C                   | Vertical Scale   | (Resistance Bulb-Thermistor) | Analog         |
| ENGINE 2        | ENG 2 OIL TEMP    | -50-180°C  | 40-135°C       | 130-150°C               | Above 150°C                   | Vertical Scale   | (Resistance Bulb-Thermistor) | Analog         |
| ENGINE 1        | ENG 1 OIL PRESS   | 0-130 PSI  | 45-100 PSI     | 25-45 PSI               | Below 25 PSI<br>Above 100 PSI | Vertical Scale   | Transducer                   | Analog         |
| ENGINE 2        | ENG 2 OIL PRESS   | 0-130 PSI  | 45-100 PSI     | 25-45 PSI               | Below 25 PSI<br>Above 100 PSI | Vertical Scale   | Transducer                   | Analog         |
| POWER TURBINE 1 | TIT 1             | 0-1000°C   | 0-775°C        | 775-850°C               | Above 850°C                   | Vertical+Digital | Thermocouple (Harness Probe) | Analog         |
| POWER TURBINE 2 | TIT 2             | 0-1000°C   | 0-775°C        | 775-850°C               | Above 850°C                   | Vertical+Digital | Thermocouple (Harness Probe) | Analog         |
| POWER TURBINE 1 | N <sub>P</sub> 1  | 0-130%     | 95-103%        | 90-95%/103-110%         | Below 90%/Above 110%          | Vertical Scale   | Dual Purpose Sensor          | Frequency      |
| POWER TURBINE 2 | N <sub>P</sub> 2  | 0-130%     | 95-103%        | 90-95%/103-110%         | Below 90%/Above 110%          | Vertical Scale   | Dual Purpose Sensor          | Frequency      |
| GAS GENERATOR 1 | N <sub>G</sub> 1  | 0-110%     | 0-98%          | 98-104%                 | Above 104%                    | Vertical+Digital | Tach Pulse Sensor            | Frequency      |
| GAS GENERATOR 2 | N <sub>G</sub> 2  | 0-110%     | 0-98%          | 98-104%                 | Above 104%                    | Vertical+Digital | Tach Pulse Sensor            | Frequency      |
| ENGINE 1        | % TORQUE E1       | 0-145%     | 0-104%         | 104-114%                | Above 114%                    | Vertical+Digital | Shaft Twist Sensor           | Analog         |
| ENGINE 2        | % TORQUE E2       | 0-145%     | 0-104%         | 104-114%                | Above 114%                    | Vertical+Digital | Shaft Twist Sensor           | Analog         |
| MAIN ROTOR      | N <sub>R</sub>    | 0-140%     | 95-103%        | 90-95%                  | Below 90%                     | Vertical Scale   | Rotor Tachometer             | Frequency      |
| MAIN ROTOR      | OVERSPEED         | -          | -              | -                       | a 125%<br>a 135%<br>a 140%    | Light            | Rotor Tach Indicator         | Frequency      |

TABLE 2. UH-60A PARAMETERS DISPLAYED VIA WARNING/CAUTION/ADVISORY LIGHTS.

| SUBSYSTEM          | PARAMETER INDICATION  | INDICATOR  | EXPLANATION   | SIGNAL SOURCE             | PARAMETER TYPE     |
|--------------------|-----------------------|--|---|---------------------------|--------------------|
| CAUTION            | MASTER CAUTION        | Master Caution Light                             | Advises that caution light is illuminated                       | Caution Panel             | Discrete           |
| GAS GENERATOR 1    | #1 ENGINE OIL         | Warning Light                                    | Left engine Ng at or below 55%                                  | Gas Generator Tach Sensor | Discrete           |
| GAS GENERATOR 2    | #2 ENGINE OIL         | Warning Light                                    | Right engine Ng at or below 55%                                 | Gas Generator Tach Sensor | Discrete           |
| ENG 1, ENG 2, APU  | FIRE                  | Warning Light, T-Handle                          | Fire is detected in Engine 1, 2 or APU/Infra-red Optical Sensor | Rotor Tachometer          | Frequency Discrete |
| MAIN ROTOR         | LOW ROTOR RPM         | Warning Light (Flashing) and steady audible tone | Rotor RPM is below 95% Ng.                                      | Capacitive Sensor         | Analog             |
| FUEL 1             | FUEL 1 LOW            | Caution Light                                    | Tank level below 170-190 LBS                                    | Capacitive Sensor         | Analog             |
| FUEL 2             | FUEL 2 LOW            | Caution Light                                    | Tank level below 170-190 LBS                                    | Capacitive Sensor         | Analog             |
| FUEL               | #1 FUEL PRESSURE      | Caution Light                                    | Left tank pressure below 8.5±0.5 PSI                            | Pressure Switch           | Discrete           |
| FUEL               | #2 FUEL PRESSURE      | Caution Light                                    | Right tank pressure below 8.5±0.5 PSI                           | Pressure Switch           | Discrete           |
| #1 ENGINE OIL      | #1 ENG OIL PRESSURE   | Caution Light                                    | Left engine oil pressure below 25 PSI                           | Transducer                | Analog             |
| #2 ENGINE OIL      | #2 ENG OIL PRESSURE   | Caution Light                                    | Right engine oil pressure below 25 PSI                          | Transducer                | Analog             |
| #1 ENGINE OIL      | #1 ENG OIL TEMP       | Caution Light                                    | Left engine oil temp above 150°C                                | Thermistor                | Analog             |
| #2 ENGINE OIL      | #2 ENG OIL TEMP       | Caution Light                                    | Right engine oil temp above 150°C                               | Thermistor                | Analog             |
| #1 ENGINE SCAVENGE | CHIP #1 ENGINE        | Caution Light                                    | Left engine: metal chip or particle buildup                     | Magnetic Detector         | Discrete           |
| #2 ENGINE SCAVENGE | CHIP #2 ENGINE        | Caution Light                                    | Right engine: metal chip or particle buildup                    | Magnetic Detector         | Discrete           |
| #1 FUEL FILTER     | #1 FUEL FILTER BYPASS | Caution Light                                    | 7.5 PSID across left fuel filter                                | Mechanical Limit Switch   | Discrete           |
| #2 FUEL FILTER     | #2 FUEL FILTER BYPASS | Caution Light                                    | 7.5 PSID across right fuel filter                               | Mechanical Limit Switch   | Discrete           |
| #1 ENGINE STARTER  | #1 ENGINE STARTER     | Caution Light                                    | Left engine start valve open (Ng reaches 20%)                   | Pressure Switch           | Discrete           |
| #2 ENGINE STARTER  | #2 ENGINE STARTER     | Caution Light                                    | Right engine start valve open (Ng reaches 20%)                  | Pressure Switch           | Discrete           |
| #1 HYDRAULIC POWER | #1 PRI SERVO PRESS    | Caution Light                                    | First stage pressure below 2000 ± 50 PSI                        | Pressure Switch           | Discrete           |
| #2 HYDRAULIC POWER | #2 PRI SERVO PRESS    | Caution Light                                    | Second stage pressure below 2000 ± 50 PSI                       | Pressure Switch           | Discrete           |

TABLE 2. CONTINUED.

| SUBSYSTEM           | PARAMETER INDICATION | INDICATOR     | EXPLANATION  | SIGNAL SOURCE                         | PARAMETER TYPE |
|---------------------|----------------------|---------------|--|---------------------------------------|----------------|
| #1 ENGINE GENERATOR | #1 GEN               | Caution Light | Voltage: one phase below 95V or all above 105V   | Voltmeter                             | Discrete       |
| #2 ENGINE GENERATOR | #2 GEN               | Caution Light | Current: $20 \pm 4$ amp differential between transformers<br>Frequency: below $370 \pm 4$ Hz     | Ammeter                               | Discrete       |
| #1 CONVERTER        | #1 CONV              | Caution Light | No output from left converter  | Relay Switch                          | Discrete       |
| #2 CONVERTER        | #2 CONV              | Caution Light | No output from right converter   | Relay Switch                          | Discrete       |
| #1 ENGINE OIL       | #1 OIL FILTER BYPASS | Caution Light | Left engine oil pressure at filter is 60-80 PSID   | Mechanical Limit Switch               | Discrete       |
| #2 ENGINE OIL       | #2 OIL FILTER BYPASS | Caution Light | Right engine oil pressure at filter is 60-80 PSID  | Mechanical Limit Switch               | Discrete       |
| #1 HYDRAULIC PUMP   | #1 HYD PUMP          | Caution Light | Left hydraulic pump output pressure below $2000 \pm 50$ PSI                                      | Pressure Controlled                   | Discrete       |
| #2 HYDRAULIC PUMP   | #2 HYD PUMP          | Caution Light | Right hydraulic pump output pressure below $2000 \pm 50$ PSI                                     | Mechanical Switch                     | Discrete       |
| #1 HYDRAULIC POWER  | #1 PRI SERVO JAM     | Caution Light | Restricted pilot valve on first stage of one or more primary servos, or servo is in auto bypass  | Pressure Controlled Mechanical Switch | Discrete       |
| #2 HYDRAULIC POWER  | #2 PRI SERVO JAM     | Caution Light | Restricted pilot valve on second stage of one or more primary servos, or servo is in auto bypass | Pressure Controlled Mechanical Switch | Discrete       |
| BOOST SERVOS        | BOOST SERVO JAM      | Caution Light | Yaw or collective servo pilot valve restricted   | Pressure Controlled Mechanical Switch | Discrete       |
| MAIN XMSN           | CHIP MAIN XMSN       | Caution Light | Metallic chip or particle Buildup  | Magnetic Detector                     | Discrete       |
| MAIN XMSN           | MAIN XMSN OIL PRESS  | Caution Light | XMSN oil pressure below $14 \pm 2$ PSI   | Pressure Switch                       | Discrete       |
| AC POWER            | AC ESS BUS OFF       | Caution Light | No power being supplied to AC essential bus  | Relay Switch                          | Discrete       |
| BATTERY             | BATT LOW CHARGE      | Caution Light | Battery charge below 41% of full charge state  | 20th Cell                             | Discrete       |
| MAIN ROTOR          | GUST LOCK            | Caution Light | Gust lock not fully disengaged   | Mechanical Switch                     | Discrete       |
| MAIN XMSN           | MAIN XMSN OIL TEMP   | Caution Light | XMSN oil temperature above $112.8-121^{\circ}\text{C}$   | Temperature Sensor                    | Discrete       |

TABLE 2. CONTINUED.

| SUBSYSTEM       | PARAMETER INDICATION | INDICATOR          | EXPLANATION  | SIGNAL SOURCE        | PARAMETER TYPE |
|-----------------|----------------------|--------------------|--|----------------------|----------------|
| FLT PATH STAB   | FLT PATH STAB        | Caution Light      | Failure within flight path stabilization system                                    | FAS Computer         | Discrete       |
| DC POWER        | DC ESS BUS OFF       | Caution Light      | No power being supplied to DC essential bus  | Relay Switch         | Discrete       |
| BATTERY         | BATTERY FAULT        | Caution Light      | Safe operating temperature exceeded or call dissimilarity                          | Temp/Press Sensors   | Discrete       |
| PITCH BIAS ACT  | PITCH BIAS FAIL      | Caution Light      | Pitch bias actuator malfunction  | Pitch Bias Actuator  | Discrete       |
| HYDRAULIC       | BOOST SERVO OFF      | Caution Light      | Pressure below 2000 $\pm$ 50 PSI or off to yaw/collective boost servos             | Pressure Switch      | Discrete       |
| STABILATOR      | STABILATOR           | Caution Light/Tone | Stabilator auto mode inoperative   | Logic Network        | Discrete       |
| SAS             | SAS OFF              | Caution Light      | SAS pressure below 2000 $\pm$ 50 PSI   | Pressure Switch      | Discrete       |
| HYDRAULIC       | TAIL ROTOR SERVO JAM | Caution Light      | Restricted pilot valve or in auto bypass mode                                      | Pressure Switch      | Discrete       |
| APU             | SEQUENCE FAIL APU    | Caution Light      | Fails to accelerate from 5% to 70% in 60 seconds during start                      | Magnetic Pickup Tach | Discrete       |
| APU             | APU OVERSPEED        | Caution Light      | APU speed exceeds 110%   | Magnetic Pickup Tach | Discrete       |
| APU             | APU UNDERSPEED       | Caution Light      | APU speed drops below 90% after exceeding 90%                                      | Magnetic Pickup Tach | Discrete       |
| APU             | APU EXHAUST TEMP HI  | Caution Light      | APU exhaust temperature exceeds 660 $\pm$ 110C                                     | Temperature Sensor   | Discrete       |
| APU             | APU OIL PRESS        | Caution Light      | APU oil pressure below 6 $\pm$ 1 PSI, and speed above 90%                          | Pressure Switch      | Discrete       |
| IFF             | IFF                  | Caution Light      | Mode 4 is being interrogated but is not responding                                 | IFF Panel System     | Discrete       |
| #1 ENG ANTI-ICE | #1 ENG ANTI-ICE ON   | Advisory Light     | Left engine anti-ice switch on, valves open, or inlet temp exceeds 93C             | Switch, Temp Sensor  | Discrete       |
| #2 ENG ANTI-ICE | #2 ENG ANTI-ICE ON   | Advisory Light     | Right engine anti-ice switch on, valves open, or inlet temp exceeds 93C            | Switch, Temp Sensor  | Discrete       |
| APU             | APU GEN ON           | Advisory Light     | All phase above 105 V; less than 20 $\pm$ 4 amp differential; above 370 $\pm$ 4 Hz | Volt/Ammeter         | Discrete       |

TABLE 2. CONTINUED.

| SUBSYSTEM     | PARAMETER INDICATION | INDICATOR      | EXPLANATION  | SIGNAL SOURCE         | PARAMETER TYPE |
|---------------|----------------------|----------------|--|-----------------------|----------------|
| PITOT         | PITOT HEAT ON        | Advisory Light | Pitot heat switch is on                                    | Switch                | Discrete       |
| HYDRAULIC     | BACKUP PUMP ON       | Advisory Light | Backup pump pressure operating above 2000 $\pm$ 50 PSI     | Pressure Switch       | Discrete       |
| PARKING BRAKE | PARKING BRAKE ON     | Advisory Light | Parking brake handle has been pulled                       | Mechanical Switch     | Discrete       |
| CARGO HOOK    | CARGO HOOK OPEN      | Advisory Light | Hook load beam unlocked                                    | Mechanical Switch     | Discrete       |
| CARGO HOOK    | HOOK ARMED           | Advisory Light | Cargo hook switch is at ARMED                              | Electrical Switch     | Discrete       |
| EXTERNAL PWR  | EXT PWR CONNECTED    | Advisory Light | AC external power connected and DC power is on battery bus | Jumper Wire           | Discrete       |
| INT XMSN      | INT XMSN CHIP        | Caution Light  | Metal chip or particle buildup in intermediate gearbox     | Magnetic Detector     | Discrete       |
| TAIL XMSN     | TAIL XMSN CHIP       | Caution Light  | Metal chip or particle buildup                             | Magnetic Detector     | Discrete       |
| APU           | APU ON               | Advisory Light | APU switch at RUN or START and above 15%                   | Switch, Magnetic Tach | Discrete       |
| FUEL          | PRIME BOOST PUMP ON  | Advisory Light | Switch at PRIME or BOOST, no T-handle pulled               | Switch                | Discrete       |

TABLE 3. CH-47C PARAMETERS DISPLAYED VIA ANALOG INSTRUMENTS.

| SUBSYSTEM | PARAMETER         | RANGE        | NORMAL OP BAND           | PRECAUTION LIMITS    | MAFUNCTION LIMITS         | INDICATOR | SIGNAL SOURCE         | PARAMETER TYPE |
|-----------|-------------------|--------------|--------------------------|----------------------|---------------------------|-----------|-----------------------|----------------|
| FUEL      | FUEL QUANTITY 1   | 0-2500 LBS   | 450-2500 LBS             | 0-450 LBS            | -                         | Dial      | Capacitance Probes    | Analog         |
| FUEL      | FUEL QUANTITY 2   | 0-2500 LBS   | 450-2500 LBS             | 0-450 LBS            | -                         | Dial      | Capacitance Probes    | Analog         |
| FUEL      | FUEL QUANTITY-TOT | 0-5000 LBS   | 900-5000 LBS             | 0-900 LBS            | -                         | Dial      | Capacitance Probes    | Analog         |
| ENGINE 1  | TORQUE 1          | 0-1300 LB/FT | 0-890 LB/FT              | -                    | Above 890 LB/FT           | Dial      | Electric Torquemeter  | Analog         |
| ENGINE 2  | TORQUE 2          | 0-1300 LB/FT | 0-890 LB/FT              | -                    | Above 890 LB/FT           | Dial      | Electric Torquemeter  | Analog         |
| ROTOR     | N <sub>R</sub>    | 0-290 RPM    | 223-233 RPM              | 204-223 RPM          | Above 233 RPM             | Dial      | Tachometer            | Frequency      |
| GAS GEN 1 | N <sub>G</sub> 1  | 0-110%       | (MARKED FOR EACH ENGINE) | -                    | -                         | Dial      | Tach Pulse Sensor     | Frequency      |
| GAS GEN 2 | N <sub>G</sub> 2  | 0-110%       | (MARKED FOR EACH ENGINE) | -                    | -                         | Dial      | Tach Pulse Sensor     | Frequency      |
| ENG 1     | ENG 1 OIL TEMP    | -70-150°C    | -70-138°C                | -                    | Above 138°C               | Dial      | Bimetallic Temp Probe | Analog         |
| ENG 2     | ENG 2 OIL TEMP    | -70-150°C    | -70-138°C                | -                    | Above 138°C               | Dial      | Bimetallic Temp Probe | Analog         |
| ENG 1     | ENG 1 OIL PRESS   | 0-200 PSI    | 50-90 PSI                | 40-50 PSI/90-110 PSI | Below 40/Above 90 PSI     | Dial      | Pressure Transmitter  | Analog         |
| ENG 2     | ENG 2 OIL PRESS   | 0-200 PSI    | 50-90 PSI                | 40-50 PSI/90-110 PSI | Below 40/Above 90 PSI     | Dial      | Pressure Transmitter  | Analog         |
| XMSN      | XMSN OIL TEMP     | -70-150°C    | -70-130°C                | 130-140°C            | Above 140°C               | Dial      | Temperature Probe     | Analog         |
| XMSN      | XMSN OIL PRESS    | 0-100 PSI    | 20-90 PSI                | -                    | Below 20/Above 90 PSI     | Dial      | Pressure Transducer   | Analog         |
| HYDRAULIC | FLT CTL PRESS 1   | 0-4000 PSI   | 2500-3200 PSI            | -                    | Below 2500/Above 3200 PSI | Dial      | Pressure Transmitter  | Analog         |
| HYDRAULIC | FLT CTL PRESS 2   | 0-4000 PSI   | 2500-3200 PSI            | -                    | Below 2500/Above 3200 PSI | Dial      | Pressure Transmitter  | Analog         |
| HYDRAULIC | UTIL HYD PRESS    | 0-4000 PSI   | 2500-3400 PSI            | -                    | Below 2500/Above 3400 PSI | Dial      | Pressure Transmitter  | Analog         |
| ENGINE 1  | EGT 1             | 0-1000°C     | 230-620°C                | -                    | Above 620°C               | Dial      | Thermocouple Probe    | Analog         |
| ENGINE 2  | EGT 2             | 0-1000°C     | 230-620°C                | -                    | Above 620°C               | Dial      | Thermocouple Probe    | Analog         |
| AC        | AC LOADMETER      | 0-100%       | -                        | -                    | -                         | Dial      | AC Gen Output         | Analog         |
| DC        | DC LOADMETER      | 0-100%       | -                        | -                    | -                         | Dial      | Rectifier Output      | Analog         |

TABLE 4. CH-47C PARAMETERS DISPLAYED VIA WARNING/CAUTION LIGHTS.

| SUBSYSTEM      | PARAMETER INDICATION | INDICATOR      | EXPLANATION   | SIGNAL SOURCE           | PARAMETER TYPE |
|----------------|----------------------|----------------|---|-------------------------|----------------|
| CAUTION        | MASTER CAUTION       | Master Caution | Advises that caution light is illuminated   | Caution Panel           | Discrete       |
| #1 ENGINE      | #1 ENG OIL LOW       | Caution Light  | Less than 2 qts usable oil in #1 oil tank   | Indicator Microswitch   | Discrete       |
| #2 ENGINE      | #2 ENG OIL LOW       | Caution Light  | Less than 2 qts usable oil in #2 oil tank   | Indicator Microswitch   | Discrete       |
| #1 ENG/XMSN    | #1 ENG CHIP DET      | Caution Light  | Metallic particles in #1 eng oil or XMSN  | Magnetic Det, Elec Grid | Discrete       |
| #2 ENG/XMSN    | #2 ENG CHIP DET      | Caution Light  | Metallic particles in #2 eng oil or XMSN  | Magnetic Det, Elec Grid | Discrete       |
| FUEL           | L FUEL PRESS         | Caution Light  | Left fuel pressure below 10 PSI   | Pressure Switch         | Discrete       |
| FUEL           | R FUEL PRESS         | Caution Light  | Right fuel pressure below 10 PSI  | Pressure Switch         | Discrete       |
| XMSN           | XMSN OIL HOT         | Caution Light  | Indicated temperature needs 130°C   | Indicator Microswitch   | Discrete       |
| XMSN           | XMSN OIL PRESS       | Caution Light  | Indicated pressure less than 20 PSI   | Indicator Microswitch   | Discrete       |
| XMSN           | XMSN CHIP DET        | Caution Light  | Metal particles in oil of aft combining XMSN or aft vertical shaft thrust bearing | Magnetic Switch         | Discrete       |
| HYDRAULIC      | #1 HYD BOOST OFF     | Caution Light  | #1 Flt ctl hyd press below 2000 PSI   | Pressure Switch         | Discrete       |
| HYDRAULIC      | #2 HYD BOOST OFF     | Caution Light  | #2 Flt ctl hyd press below 2000 PSI   | Pressure Switch         | Discrete       |
| #1 SAS         | #1 SAS OFF           | Caution Light  | #1 SAS locked out by EMER REL SAS Switch  | SAS Panel Microswitch   | Discrete       |
| #2 SAS         | #2 SAS OFF           | Caution Light  | #2 SAS locked out by EMER REL SAS Switch  | SAS Panel Microswitch   | Discrete       |
| #1 GEN         | #1 GEN OFF           | Caution Light  | #1 GEN inoperative or switch at OFF   | Relay Switch            | Discrete       |
| #2 GEN         | #2 GEN OFF           | Caution Light  | #2 GEN inoperative or switch at OFF   | Relay Switch            | Discrete       |
| #1 TRANSFORMER | #1 RECT OFF          | Caution Light  | #1 Transformer - Rectifier has failed   | Reverse Current Cutout  | Discrete       |
| #2 TRANSFORMER | #2 RECT OFF          | Caution Light  | #2 Transformer - Rectifier has failed   | Reverse Current Cutout  | Discrete       |

TABLE 4. CONTINUED.

| SUBSYSTEM     | PARAMETER INDICATION | INDICATOR                | EXPLANATION   | SIGNAL SOURCE                | PARAMETER TYPE |
|---------------|----------------------|--------------------------|---|------------------------------|----------------|
| #1 ENG        | #1 ENG N1 CONT       | Caution Light            | #1 eng N1 control loop energized, or eng cond lever is not on stop, ground, or flight | Quadrant Microswitches       | Discrete       |
| #2 ENG        | #2 ENG N1 CONT       | Caution Light            | #2 eng N1 control loop energized, or eng cond lever is not on stop, ground, or flight | Quadrant Microswitches       | Discrete       |
| CARGO HOOK    | CARGO HOOK OPEN      | Caution Light            | Cargo hook is open  | Microswitch                  | Discrete       |
| PARKING BRAKE | PARK BRAKE ON        | Caution Light            | Parking brake is on   | Microswitch                  | Discrete       |
| HEATER        | HEATER HOT           | Caution Light            | Temperature within heater exceeds 350°F   | Temp Controller Relay Switch | Discrete       |
| LANDING GEAR  | WHEEL DE-PHASED      | Caution Light            | Aft right landing gear exceeds 58° LT or 82° RT                                       | Phase Switch                 | Discrete       |
| AC EXT PMR    | AC EXT PMR ON        | Caution Light            | AC external power connected, in use   | Relay                        | Discrete       |
| DC EXT PMR    | DC EXT PMR ON        | Caution Light            | DC external power connected, in use   | Relay                        | Discrete       |
| #1 ENG        | (ENGINE FIRE)        | Control Handle Warn. Lt. | Fire in engine #1   | Electrical Network           | Discrete       |
| #2 ENG        | (ENGINE FIRE)        | Control Handle Warn. Lt. | Fire in engine #2   | Electrical Network           | Discrete       |

TABLE 5. OH-58C PARAMETERS DISPLAYED VIA ANALOG INSTRUMENTS.

| SUBSYSTEM     | PARAMETER      | RANGE      | NORMAL OP BAND | PRECAUTION LIMITS | MAJFUNCTION LIMITS    | INDICATOR | SIGNAL SOURCE                 | PARAMETER TYPE |
|---------------|----------------|------------|----------------|-------------------|-----------------------|-----------|-------------------------------|----------------|
| FUEL          | FUEL QUANTITY  | 0-600 LBS. | 65-600 LBS.    | BELOW 65 LBS.     | -                     | DIAL      | UPPER/LOWER TRANSMITTERS      | ANALOG         |
| GAS PRODUCER  | N <sub>G</sub> | 0-106%     | 62-105%        | -                 | ABOVE 105%            | DIAL      | TACH GENERATOR                | FREQUENCY      |
| MAIN ROTOR    | N <sub>R</sub> | 0-120%     | 93-110%        | -                 | BELOW 93/ABOVE 110%   | DIAL      | TACH GENERATOR                | FREQUENCY      |
| POWER TURBINE | N <sub>P</sub> | 0-120%     | 98-100%        | -                 | ABOVE 100%            | DIAL      | TACH GENERATOR                | FREQUENCY      |
| ENGINE        | TORQUE         | 0-120%     | 0-85%          | 85-100%           | ABOVE 100%            | DIAL      | PRESS SENSING PORT            | ANALOG         |
| ENGINE        | ENG OIL PRESS  | 0-150PSI   | 110-130PSI     | 50-110PSI         | BELOW 50/ABOVE 130PSI | DIAL      | DIR.READ,NET LINE PRESS SENS. | ANALOG         |
| ENGINE        | ENG OIL TEMP   | -50 -150°C | 60-107°C       | -                 | ABOVE 107°C           | DIAL      | ELEC.RESIST.THERMOCOUPLE      | ANALOG         |
| XMSN          | XMSN OIL PRESS | 0-100 PSI  | 30-60 PSI      | 60-70 PSI         | BELOW 30/ABOVE 70 PSI | DIAL      | PRESSURE TRANSDUCER           | ANALOG         |
| ENGINE        | TOT            | 0-1000°C   | 300-738°C      | 738-810°C         | ABOVE 810°C           | DIAL      | THERMOCOUPLE PROBE            | ANALOG         |
| DC POWER      | AMMETER        | 0-150 AMPS | 0-140 AMPS     | -                 | ABOVE 140 AMPS        | DIAL      | DC OUTPUT                     | ANALOG         |

TABLE 6. OH-58C PARAMETERS DISPLAYED VIA WARNING/CAUTION LIGHTS.

| <u>SUBSYSTEM</u> | <u>PARAMETER INDICATION</u> | <u>INDICATOR</u>     | <u>EXPLANATION</u>                             | <u>SIGNAL SOURCE</u>     | <u>PARAMETER TYPE</u> |
|------------------|-----------------------------|----------------------|--|--------------------------|-----------------------|
| CAUTION          | MASTER CAUTION              | MASTER CAUTION LIGHT | ADVISES THAT CAUTION LIGHT IS ILLUMINATED      | CAUTION PANEL            | DISCRETE              |
| ENGINE           | ENGINE OIL                  | WARNING LIGHT/TONE   | N <sub>6</sub> IS LESS THAN 55 ± 3%            | TACH PULSE SENSOR        | DISCRETE              |
| MAIN ROTOR       | ROTOR RPM                   | WARNING LIGHT/TONE   | MAIN ROTOR RPM BELOW 95 ± 1.4%                 | TACH PULSE SENSOR        | DISCRETE              |
| XMSN             | XMSN OIL PRESS              | WARNING LIGHT        | XMSN OIL PRESSURE BELOW 30 PSI                 | PRESSURE SWITCH          | DISCRETE              |
| XMSN             | XMSN OIL HOT                | WARNING LIGHT        | XMSN OIL TEMPERATURE EXCEEDS 110°C             | TEMPERATURE SENSOR       | DISCRETE              |
| FUEL             | FUEL BOOST                  | CAUTION LIGHT        | FUEL BOOST PRESSURE BELOW OPERATING LIMITS     | PRESSURE SWITCH          | DISCRETE              |
| FUEL             | 20 MIN FUEL                 | CAUTION LIGHT        | LESS THAN 65 LBS FUEL REMAINING                | LOW LEVEL SWITCH         | DISCRETE              |
| FUEL             | FUEL FILTER                 | CAUTION LIGHT        | FUEL FILTER PARTIALLY OBSTRUCTED               | PRESSURE SWITCH          | DISCRETE              |
| ENGINE           | ENG OIL BYPASS              | CAUTION LIGHT        | OIL TANK LEVEL MORE THAN 3 PINTS LOW           | LOW LEVEL SWITCH         | DISCRETE              |
| ENGINE           | ENG CHIP DET                | CAUTION LIGHT        | METAL PARTICLES DETECTED IN ENGINE             | MAGNETIC CHIP DETECTOR   | DISCRETE              |
| XMSN             | XMSN CHIP DET               | CAUTION LIGHT        | METAL PARTICLES DETECTED IN XMSN               | ELECTRICAL CHIP DETECTOR | DISCRETE              |
| TAIL ROTOR       | T/R CHIP DET                | CAUTION LIGHT        | METAL PARTICLES DETECTED IN TAIL ROTOR GEARBOX | ELECTRICAL CHIP DETECTOR | DISCRETE              |
| AC INVERTER      | INST INVERTER               | CAUTION LIGHT        | NO OUTPUT FROM AC INVERTER                     | AC FAIL RELAY            | DISCRETE              |
| DC GENERATOR     | DC GENERATOR                | CAUTION LIGHT        | NO OUTPUT FROM DC GENERATOR                    | GEN FAIL RELAY           | DISCRETE              |
| HYDRAULIC        | HYD PRESS                   | CAUTION LIGHT        | HYDRAULIC PRESSURE BELOW NORMAL                | PRESSURE SWITCH          | DISCRETE              |
| IFF              | IFF                         | CAUTION LIGHT        | IFF SYSTEM INOPERATIVE                         | IFF PANEL SYSTEMS        | DISCRETE              |

TABLE 7. AH-1G PARAMETERS DISPLAYED VIA ANALOG INSTRUMENTS.

| SUBSYSTEM  | PARAMETER      | RANGE      | NORMAL OP BAND | PRECAUTION LIMITS | MALFUNCTION LIMITS     | INDICATOR | PILOT GUNNER BOTH | SIGNAL SOURCE            | PARAMETER TYPE |
|------------|----------------|------------|----------------|-------------------|------------------------|-----------|-------------------|--------------------------|----------------|
| FUEL       | FUEL QUANTITY  | 0-170CLBS. | 170-1700 LBS   | 0-170 LBS         | -                      | DIAL      | X                 | CAPACITATIVE TRANSMITTER | ANALOG         |
| FUEL       | FUEL PRESSURE  | 0-50 PSI   | 5-30 PSI       | -                 | BELOW 5/ABOVE 30 PSI   | DIAL      | X                 | PRESSURE TRANSMITTER     | ANALOG         |
| ENGINE     | ENG OIL PRESS  | 0-100 PSI  | 80-100 PSI     | -                 | BELOW 25/ABOVE 100 PSI | DIAL      | X                 | PRESSURE TRANSMITTER     | ANALOG         |
| ENGINE     | ENG OIL TEMP   | -70 -150°C | 0-93°C         | -                 | ABOVE 93°C             | DIAL      | X                 | ELEC. RES. THERMOCOUPLE  | ANALOG         |
| XMSN       | XMSN OIL PRESS | 0-100 PSI  | 40-60 PSI      | -                 | BELOW 30/ABOVE 70 PSI  | DIAL      | X                 | PRESSURE TRANSMITTER     | ANALOG         |
| XMSN       | XMSN OIL TEMP  | -70 -150°C | 0-110°C        | -                 | ABOVE 110°C            | DIAL      | X                 | ELEC. RES. THERMOBULB    | ANALOG         |
| MAIN ROTOR | N <sub>R</sub> | 0-360 RPM  | 294-324 RPM    | -                 | ABOVE 339 RPM          | DIAL      | X                 | TACH GENERATOR           | FREQUENCY      |
| ENGINE     | N <sub>P</sub> | 0-7200 RPM | 6400-6600 RPM  | 6000-6400 RPM     | ABOVE 6600 RPM         | DIAL      | X                 | TACH GENERATOR           | FREQUENCY      |
| ENGINE     | N <sub>G</sub> | 0-104%     | 0-101.5%       | -                 | ABOVE 101.5%           | DIAL      | X                 | TACH GENERATOR           | FREQUENCY      |
| ENGINE     | TORQUE         | 0-100 PSI  | 0-50 PSI       | -                 | ABOVE 50 PSI           | DIAL      | X                 | SHAFT TRANSMITTER        | ANALOG         |
| ENGINE     | EGT            | 0-1000°C   | 400-610°C      | 610-625°C         | ABOVE 625°C            | DIAL      | X                 | BAYONET THERMOCOUPLE     | ANALOG         |
| DC POWER   | DC POWER       | -          | -              | -                 | -                      | DIAL      | X                 | VOLTMETER/AMMETER        | ANALOG         |

TABLE 8. AH-1G PARAMETERS DISPLAYED VIA WARNING/CAUTION LIGHTS.

| SUBSYSTEM  | PARAMETER        | INDICATION | INDICATOR          | PILOT | 8TH GUNNER | EXPLANATION                                   | SIGNAL SOURCE              | PARAMETER TYPE |
|------------|------------------|------------|--------------------|-------|------------|---|----------------------------|----------------|
| CAUTION    | MASTER CAUTION   |            | MASTER CAUTION     |       |            | X ADVISES THAT CAUTION LIGHT IS ILLUMINATED   | CAUTION PANEL              | DISCRETE       |
| MAIN ROTOR | ROTOR RPM        |            | WARNING LIGHT/TONE |       |            | X ROTOR RPM BELOW 295 OR ABOVE 305 RPM        | ROTOR TACHOMETER           | DISCRETE       |
| ENGINE     | ENG OIL PRESS    |            | CAUTION LIGHT      |       |            | X ENGINE OIL PRESSURE BELOW 25 PSI            | LOW PRESSURE SWITCH        | DISCRETE       |
| ENGINE     | ENGINE INLET AIR |            | CAUTION LIGHT      |       |            | X NEGATIVE AIR PRESSURE IN ENG INDUCTION SYS. | NEGATIVE PRESSURE SWITCH   | DISCRETE       |
| ENGINE     | ENG OIL BYPASS   |            | CAUTION LIGHT      | X     |            | OIL LEVEL DOWN 3.8 QTS. FROM FULL             | LOW LEVEL SWITCH           | DISCRETE       |
| FUEL       | FWD FUEL BOOST   |            | CAUTION LIGHT      | X     |            | FWD FUEL BOOST PUMP PRESSURE BELOW 5 PSI      | PRESSURE SWITCH            | DISCRETE       |
| FUEL       | AFT FUEL BOOST   |            | CAUTION LIGHT      | X     |            | AFT FUEL BOOST PUMP PRESSURE BELOW 5 PSI      | PRESSURE SWITCH            | DISCRETE       |
| FUEL       | FUEL PUMP        |            | CAUTION LIGHT      |       | X          | FUEL PUMP PRODUCING LOW PRESSURE              | PRESSURE SWITCH            | DISCRETE       |
| FUEL       | 10% FUEL         |            | CAUTION LIGHT      |       | X          | LESS THAN 10% (17 LBS) FUEL REMAINING         | LOW LEVEL SWITCH           | DISCRETE       |
| FUEL       | FUEL FILTER      |            | CAUTION LIGHT      |       | X          | FUEL FILTER PARTIALLY OBSTRUCTED              | PRESSURE SWITCH            | DISCRETE       |
| ENG GOV    | GOV EMER         |            | CAUTION LIGHT      |       | X          | GOVERNOR SWITCH IN EMERGENCY POSITION         | PANEL SWITCH               | DISCRETE       |
| XMSN       | XMSN OIL BYPASS  |            | CAUTION LIGHT      | X     |            | XMSN OIL BYPASSING COOLER, PRESS BELOW 30PSI  | LOW LEVEL SWITCH/PRESS SW. | DISCRETE       |
| XMSN       | XMSN OIL PRESS   |            | CAUTION LIGHT      |       | X          | XMSN OIL PRESSURE BELOW 30 PSI                | PRESSURE SWITCH            | DISCRETE       |
| XMSN       | XMSN OIL HOT     |            | CAUTION LIGHT      |       | X          | XMSN OIL TEMP AT OR ABOVE 110°C               | THERMOSWITCH               | DISCRETE       |
| HYDRAULIC  | HYD PRESS #1     |            | CAUTION LIGHT      |       | X          | SYSTEM 1 HYDRAULIC PRESSURE LOW               | PRESSURE SWITCH            | DISCRETE       |
| HYDRAULIC  | HYD PRESS #2     |            | CAUTION LIGHT      |       | X          | SYSTEM 2 HYDRAULIC PRESSURE LOW               | PRESSURE SWITCH            | DISCRETE       |
| AC INV     | INST INVERTER    |            | CAUTION LIGHT      | X     |            | NO AC POWER OUTPUT                            | AC FAIL RELAY              | DISCRETE       |
| DC GEN     | DC GENERATOR     |            | CAUTION LIGHT      |       | X          | NO DC POWER OUTPUT                            | DC GEN FAIL RELAY          | DISCRETE       |
| EXT PWR    | EXTERNAL POWER   |            | CAUTION LIGHT      | X     |            | EXTERNAL POWER CONNECTED                      | EXT PWR RELAY              | DISCRETE       |
| XMSN       | XMSN CHIP DET    |            | CAUTION LIGHT      |       | X          | METAL PARTICLES IN MAIN XMSN                  | MAGNETIC CHIP DETECTOR     | DISCRETE       |

TABLE 8. CONTINUED.

| SUBSYSTEM | PARAMETER    | INDICATION | INDICATOR     | EXPLANATION |      | SIGNAL SOURCE                  | PARAMETER TYPE |
|-----------|--------------|------------|---------------|-------------|------|--------------------------------|----------------|
|           |              |            |               | PILOT       | BOTH |                                |                |
| XMSN      | 42° CHIP DET |            | CAUTION LIGHT |             | X    | METAL PARTICLES IN 42° GEARBOX | DISCRETE       |
| XMSN      | 90° CHIP DET |            | CAUTION LIGHT |             | X    | METAL PARTICLES IN 90° GEARBOX | DISCRETE       |
| ENGINE    | ENG CHIP DET |            | CAUTION LIGHT |             | X    | METAL PARTICLES IN ENGINE      | DISCRETE       |
| IFF       | IFF          |            | CAUTION LIGHT | X           |      | IFF SYSTEM IMPERATIVE          | DISCRETE       |
|           |              |            |               |             |      | IFF SYSTEM NETWORK             |                |

TABLE 9. PARAMETERS DISPLAYED IN FOUR HELICOPTERS.

| <u>Parameter</u>          | <u>Indicator</u> * |
|---------------------------|--------------------|
| Fuel Quantity             | I                  |
| Engine Oil Temperature    | I                  |
| Engine Oil Pressure       | I                  |
| N <sub>G</sub>            | I                  |
| XMSN Oil Pressure         | I                  |
| N <sub>R</sub>            | I                  |
| % Torque                  | I                  |
| Fuel Low                  | C                  |
| Engine Chip               | C                  |
| XMSN Oil Pressure Low     | C/W                |
| XMSN Oil Temperature High | C/W                |
| Chip Main XMSN            | C                  |
| Generator Output Low      | C                  |
| Master Caution            | M                  |

\* I: analog instruments; C: caution light;  
W: warning light; M: master caution light.

TABLE 10. PARAMETERS DISPLAYED IN THREE HELICOPTERS.

| <u>Parameter</u>   | <u>Indicator</u> * | <u>Exception</u> |
|--------------------|--------------------|------------------|
| DC Load Meter      | I                  | UH-60A           |
| IFF Incoperative   | C                  | CH-47C           |
| PRI Servo Press    | C                  | CH-47C           |
| Fuel Filter Bypass | C                  | CH-47C           |
| Oil Filter Bypass  | C                  | CH-47C           |
| N <sub>p</sub>     | I                  | CH-47C           |
| Chip Tail XMSN     | C                  | CH-47C           |
| Low Rotor RPM      | W/T                | CH-47C           |
| Fuel Press Low     | C                  | OH-58C           |
| XMSN Oil Pump      | I                  | OH-58C           |

\* I: analog instruments; C: caution light  
W: warning light; T: audio tone

TABLE 11. PARAMETERS DISPLAYED IN TWO HELICOPTERS.

| <u>Parameter</u>      | <u>Indicator *</u> | <u>Helicopters Displaying Parameter</u> |        |
|-----------------------|--------------------|---|--------|
| Engine Fire           | W/C                | UH-60A                                  | CH-47C |
| Boost Servo Press Low | C                  | UH-60A                                  | CH-47C |
| Ext PWR Connected     | A/C                | UH-60A                                  | CH-47C |
| SAS Off               | C                  | UH-60A                                  | CH-47C |
| Cargo Hook Open       | A/C                | UH-60A                                  | CH-47C |
| Parking Brake On      | A/C                | UH-60A                                  | CH-47C |
| APU Overspeed         | C                  | UH-60A                                  | CH-47C |
| APU Exhaust Pump Hi   | C                  | UH-60A                                  | CH-47C |
| APU Oil Press Low     | C                  | UH-60A                                  | CH-47C |
| Eng Oil Press Low     | C                  | UH-60A                                  | AH-1G  |
| Chip Int XMSN         | C                  | UH-60A                                  | AH-1G  |
| Rotor Overspeed       | C                  | UH-60A                                  | AH-1G  |
| Engine Out            | W                  | UH-60A                                  | OH-58C |
| Fuel Boost Press Low  | C                  | OH-58C                                  | AH-1G  |
| AC Inv Output Low     | C                  | OH-58C                                  | AH-1G  |

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\* W: warning light; C: caution light; A: advisory light.

TABLE 12. PARAMETERS DISPLAYED IN ONE HELICOPTER.

| <u>Parameter</u>                      | <u>Indicator *</u> | <u>Helicopter Displaying Parameter</u> |
|---------------------------------------|--------------------|--|
| Prime Boost Bump On                   | A                  | UH-60A                                 |
| Eng Oil Temp Hi                       | C                  | UH-60A                                 |
| Hyd. Pump Press                       | C                  | UH-60A                                 |
| Pri Servo Jam                         | C                  | UH-60A                                 |
| Boost Servo Jam                       | C                  | UH-60A                                 |
| T/R Servo Press                       | C                  | UH-60A                                 |
| Backup Pump On                        | A                  | UH-60A                                 |
| APU Fire                              | W                  | UH-60A                                 |
| Stabilator Pos                        | I                  | UH-60A                                 |
| APU Underspeed                        | C                  | UH-60A                                 |
| APU Sequence Fail                     | C                  | UH-60A                                 |
| APU GEN On                            | A                  | UH-60A                                 |
| APU On                                | A                  | UH-60A                                 |
| Converter Output Low                  | C                  | UH-60A                                 |
| Batt Low Charge                       | C                  | UH-60A                                 |
| Batt Fault                            | C                  | UH-60A                                 |
| AC ESS Bus Off                        | C                  | UH-60A                                 |
| DC ESS Bus Off                        | C                  | UH-60A                                 |
| Flt Path Stab Fail                    | C                  | UH-60A                                 |
| Stab Auto In OP                       | C/T                | UH-60A                                 |
| Pitch Bias Fail                       | C                  | UH-60A                                 |
| Gust Lock Not Disengaged              | C                  | UH-60A                                 |
| Anti-Ice On                           | A                  | UH-60A                                 |
| Pitot Heat On                         | A                  | UH-60A                                 |
| Cargo Hook Armed                      | A                  | UH-60A                                 |
| Eng Start Valve Open                  | C                  | UH-60A                                 |
| Fuel Pressure                         | I                  | AH-1G                                  |
| Inlet Air Press Neg                   | C                  | AH-1G                                  |
| Eng Oil Quantity Low                  | C                  | CH-47C                                 |
| N <sub>1</sub> Control Loop Energized | C                  | CH-47C                                 |
| Flt Ctrl Hyd Press                    | I                  | CH-47C                                 |
| Utility Hyd Press                     | I                  | CH-47C                                 |
| Rectifier Off                         | C                  | CH-47C                                 |
| AC Load Meter                         | I                  | CH-47C                                 |
| Heater Hot                            | C                  | CH-47C                                 |
| Wheel De-Phased                       | C                  | CH-47C                                 |
| APU Tach                              | I                  | CH-47C                                 |

\* I: analog instruments; W: warning light; C: caution light;  
A: advisory light; T: audio tone.

TABLE 13. UH-60A INFORMATION REQUIREMENTS.

| PARAMETER                   | PRIORITIES |         |                            | MISSION PHASE |        |       | ENVIRONMENT |          |       | DISPLAY | FORMAT | RE-<br>PONSE | FEED-<br>BACK |          |           |               |             |              |             |          |         |          |                 |                     |         |                     |
|-----------------------------|------------|---------|----------------------------|---------------|--------|-------|-------------|----------|-------|---------|--------|--------------|---------------|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|-----------------|---------------------|---------|---------------------|
|                             | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKOFF        | CRUISE | HOVER | LAND        | SHUTDOWN | NIGHT | DAY     | WVC    | INC          | NOE           | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTINABLE | AUTO NOT DESTINABLE | DISPLAY | DISPLAY UNNECESSARY |
| Fuel Quantity               | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             | X            |             |          |         |          |                 |                     |         |                     |
| Fuel Low                    | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             | X            |             |          |         |          |                 |                     |         |                     |
| Fuel Pressure               | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             | X            |             |          |         |          |                 |                     |         |                     |
| Fuel Pressure Low           |            |         |                            |               |        |       |             |          |       |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |                     |
| Fuel Filter Obstructed      |            |         |                            |               |        |       |             |          |       |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |                     |
| Prime Boost Pump On         |            | X       |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             |              |             |          | X       |          |                 |                     |         |                     |
| Fuel Boost Pressure Low     |            |         |                            |               |        |       |             |          |       |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |                     |
|                             |            |         |                            |               |        |       |             |          |       |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |                     |
| Engine Oil Temperature      | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             |              | X           |          |         |          |                 |                     |         |                     |
| Engine Oil Temperature High | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             |              | X           |          |         |          |                 |                     |         |                     |
| Engine Oil Pressure         | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             |              | X           |          |         |          |                 |                     |         |                     |
| Engine Oil Pressure Low     | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             |              | X           |          |         |          |                 |                     |         |                     |
| Engine Oil Quantity         |            |         |                            |               |        |       |             |          |       |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |                     |
| Engine Oil Quantity Low     |            |         |                            |               |        |       |             |          |       |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |                     |
| Oil Filter Bypass           | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             |              |             | X        |         |          |                 |                     |         |                     |
| Engine Chip                 | X          |         |                            |               |        |       |             |          |       |         |        |              |               |          |           | X             |             |              |             | X        |         |          |                 |                     |         |                     |
|                             |            |         |                            |               |        |       |             |          |       |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |                     |

TABLE 13. CONTINUED.

| PARAMETER                             | PRIORITIES                                      | MISSION PHASE                                  | ENVIRONMENT                                    | DISPLAY                                   | FORMAT   | RE-<br>POSE                        | FEED-<br>BACK                  |
|---------------------------------------|---|--|--|---|--|------------------------------------|--------------------------------|
|                                       | SAFETY<br>MISSION<br>MAINTENANCE<br>UNNECESSARY | TAKEOFF<br>CRUISE<br>HOVER<br>LAND<br>SHUTDOWN | NIGHT<br>DAY<br>WVC<br>JMC<br>MODE<br>ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESTABLE<br>AUTO NOT DESTABLE | DISPLAY<br>DISPLAY UNNECESSARY |
| III                                   | X   |  |  | X   | X  |                                    |                                |
| IGI                                   |   |  |  |   |  |                                    |                                |
| N <sub>p</sub>                        | X   |  |  | X   | X  |                                    |                                |
| Inlet Air Pressure Negative           |   |  |  |   |  |                                    |                                |
|                                       |   |  |  |   |  |                                    |                                |
| N <sub>g</sub>                        | X   |  |  | X   | X  |                                    |                                |
| Engine Out                            | X   |  |  | X   | X  |                                    |                                |
| N <sub>1</sub> Control loop Energized |   |  |  |   |  |                                    |                                |
|                                       |   |  |  |   |  |                                    |                                |
| IXSN Oil Pressure                     | X   |  |  | X   | X  |                                    |                                |
| IXSN Oil Pressure Low                 | X   |  |  | X   | X  |                                    |                                |
| IXSN Oil Temperature                  | X   |  |  | X   | X  |                                    |                                |
| IXSN Oil Temperature High             | X   |  |  | X   | X  |                                    |                                |
| Chip Main IXSN                        | X   |  |  | X   | X  |                                    |                                |
| Chip Int IXSN                         | X   |  |  | X   | X  |                                    |                                |
| Chip Tail IXSN                        | X   |  |  | X   | X  |                                    |                                |
| IXSN Oil Bypass                       | X   |  |  | X   | X  |                                    |                                |

TABLE 13. CONTINUED.

| PARAMETER                         | PRIORITIES |         |                            | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY | FORMAT   | RE-<br>PONSE                              | FEED-<br>BACK |             |          |         |          |                 |                     |         |                     |
|-----------------------------------|------------|---------|----------------------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|---|---------------|-------------|----------|---------|----------|-----------------|---------------------|---------|---------------------|
|                                   | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | WIND        | DAY | WNC | INC | WNC     | ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE  | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTINABLE | AUTO NOT DESTINABLE | DISPLAY | DISPLAY UNNECESSARY |
| N <sub>H</sub>                    | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Main Rotor Overspeed              | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Low Rotor RPM                     | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          | X               |                     |         | X                   |
|                                   |            |         |                            |               |        |       |      |             |     |     |     |         |          |   |               |             |          |         |          |                 |                     |         |                     |
| S Torque                          | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
|                                   |            |         |                            |               |        |       |      |             |     |     |     |         |          |   |               |             |          |         |          |                 |                     |         |                     |
| Primary Servo Pressure Low        | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Hydraulic Pump Pressure Low       | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Primary Servo Jam                 | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Boost Servo Jam                   | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Boost Servo Pressure Low          | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Tail Rotor Servo Pressure Low     | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Backup Pump On                    | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         | X        |                 |                     |         |                     |
| Flight Control Hydraulic Pressure | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
| Utility Hydraulic Pressure        | X          |         |                            |               |        |       |      |             |     |     |     |         | X        | X   | X             |             |          |         |          |                 |                     |         |                     |
|                                   |            |         |                            |               |        |       |      |             |     |     |     |         |          |   |               |             |          |         |          |                 |                     |         |                     |
|                                   |            |         |                            |               |        |       |      |             |     |     |     |         |          |   |               |             |          |         |          |                 |                     |         |                     |

TABLE 13. CONTINUED.

| PARAMETER                    | PRIORITIES |         |                  | MISSION PHASE |        |      | ENVIRONMENT |     |       | DISPLAY |     | FORMAT   |           | RE-<br>PONSE  |             | FEED-<br>BACK |             |          |         |          |                |                    |         |             |
|------------------------------|------------|---------|------------------|---------------|--------|------|-------------|-----|-------|---------|-----|----------|-----------|---------------|-------------|---------------|-------------|----------|---------|----------|----------------|--------------------|---------|-------------|
|                              | SAFETY     | MISSION | HAZARD/NECESSARY | TAKEOFF       | CRUISE | LAND | BRIGHT      | DAY | NIGHT | JMC     | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE  | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESIRABLE | AUTO NOT DESIRABLE | DISPLAY | UNNECESSARY |
| APU Exhaust Temperature High |            |         |                  |               |        |      |             |     |       |         |     |          |           |               |             |               |             |          |         |          |                |                    |         |             |
| APU Oil Pressure Low         |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             |          | X       | X        |                |                    | X       |             |
| APU Overspeed                |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             |          | X       | X        |                |                    | X       |             |
| APU Underspeed               |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             |          | X       | X        |                |                    | X       |             |
| APU Sequence Fail            |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         | X        |                |                    | X       |             |
| APU Fire                     | X          |         |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        | X       | X        |                |                    | X       |             |
| APU Generator On             |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         |          |                |                    |         |             |
| APU On                       |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         |          |                |                    |         |             |
| APU Tachometer               |            |         |                  |               |        |      |             |     |       |         |     |          |           |               |             |               |             |          |         |          |                |                    |         |             |
|                              |            |         |                  |               |        |      |             |     |       |         |     |          |           |               |             |               |             |          |         |          |                |                    |         |             |
| Generator Output             |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         |          |                |                    |         |             |
| AC Inverter Output low       |            |         |                  |               |        |      |             |     |       |         |     |          |           |               |             |               |             |          |         |          |                |                    |         |             |
| Converter Output low         |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         |          |                |                    |         |             |
| Rectifier Off                |            |         |                  |               |        |      |             |     |       |         |     |          |           |               |             |               |             |          |         |          |                |                    |         |             |
| Battery Low Charge           |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         |          |                |                    |         |             |
| Battery Fault                |            | X       |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         |          |                |                    |         |             |
| AC ESS Bus Off               | X          |         |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         |          |                |                    |         |             |
| DC ESS Bus Off               | X          |         |                  |               |        |      |             |     |       |         |     |          |           | X             |             |               |             | X        |         |          |                |                    |         |             |

TABLE 13. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |      |      |      | DISPLAY   | FORMAT       | RE-<br>PONSE    |                     | FEED-<br>BACK |
|----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|------|------|------|-----------|--------------|-----------------|---------------------|---------------|
|                            | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | WING        | WING | WING | WING | CONTINUAL | QUANTITATIVE | AUTO DESTINABLE | AUTO NOT DESTINABLE | DISPLAY       |
| AC Load Meter              |            |         |             |               |        |       |      |             |      |      |      |           |              |                 |                     |               |
| DC Load Meter              |            |         |             |               |        |       |      |             |      |      |      |           |              |                 |                     |               |
|                            |            |         |             |               |        |       |      |             |      |      |      |           |              |                 |                     |               |
| Engine Fire                | X          |         |             |               |        |       |      |             |      |      |      | X         | X            |                 |                     |               |
| Flt Path Stab Sys Fail     | X          |         |             |               |        |       |      |             |      |      |      | X         | X            |                 |                     |               |
| Stabilator Auto Mode In Op | X          |         |             |               |        |       |      |             |      |      |      | X         | X            |                 |                     |               |
| Stabilator Position        | X          |         |             |               |        |       |      |             |      |      |      | X         | X            | X               | X                   |               |
|                            |            |         |             |               |        |       |      |             |      |      |      |           |              |                 |                     |               |
| SAS Off                    | X          |         |             |               |        |       |      |             |      |      |      | X         | X            |                 |                     |               |
|                            |            |         |             |               |        |       |      |             |      |      |      |           |              |                 |                     |               |
| Pitch Bias Failure         | X          |         |             |               |        |       |      |             |      |      |      | X         | X            |                 |                     |               |
|                            |            |         |             |               |        |       |      |             |      |      |      |           |              |                 |                     |               |
| Gust Lock Not Disengaged   |            |         |             |               |        |       |      |             |      |      |      |           |              |                 |                     |               |
|                            |            |         |             |               |        |       |      |             |      |      |      |           |              |                 |                     |               |

TABLE 13. CONTINUED.

| PARAMETER             | PRIORITIES  |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY | FORMAT        | RE-<br>PONSE       | FEED-<br>BACK       |
|-----------------------|-------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|---------------|--------------------|---------------------|
|                       | SAFETY      | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | PRC | PRC | ALITUDE | CONTINUAL     | QUANTITATIVE       |                     |
|                       | UNNECESSARY |         |             |               |        |       |      |             |     |     |     |         | CRITICAL ONLY | QUALITATIVE        |                     |
|                       |             |         |             |               |        |       |      |             |     |     |     |         | ACCESS ONLY   | COMBINED           |                     |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |               | CAUTION            |                     |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |               | ADVISORY           |                     |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |               | AUTO DESIRABLE     |                     |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |               | AUTO NOT DESIRABLE |                     |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |               |                    | DISPLAY UNNECESSARY |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |               |                    | DISPLAY             |
| Eng. Anti-Ice On      | X           |         |             |               |        |       |      |             |     |     |     |         | X             |                    |                     |
| Pilot Heat On         | X           |         |             |               |        |       |      |             |     |     |     |         | X             |                    |                     |
| Heater On             |             |         |             |               |        |       |      |             |     |     |     |         |               |                    |                     |
| Heater Hot            |             |         |             |               |        |       |      |             |     |     |     |         |               |                    |                     |
| Cargo Hook Open       | X           |         |             |               |        |       |      |             |     |     |     |         | X             |                    |                     |
| Cargo Hook Armed      | X           |         |             |               |        |       |      |             |     |     |     |         | X             |                    |                     |
| Parking Brake On      | X           |         |             |               |        |       |      |             |     |     |     |         | X             |                    |                     |
| Eng. Start Valve Open | X           |         |             |               |        |       |      |             |     |     |     |         | X             |                    |                     |
| Master Caution        | X           |         |             |               |        |       |      |             |     |     |     |         | X             |                    |                     |

TABLE 14. CH-47C INFORMATION REQUIREMENTS.

| PARAMETER                   | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |      |       |          | DISPLAY                                 | FORMAT   | RE-<br>PONSE                           | FEED-<br>BACK                  |
|-----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|------|-------|----------|---|--|--|--------------------------------|
|                             | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | WIND        | TEMP | MOIST | ALTITUDE | CENTRAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESTINABLE<br>AUTO NOT DESTINABLE | DISPLAY<br>DISPLAY UNNECESSARY |
| Fuel Quantity               | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |
| Fuel Low                    | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |
| Fuel Pressure               | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |
| Fuel Pressure Low           | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |
| Fuel Filter Obstructed      |            |         |             |               |        |       |      |             |      |       |          |   |  |  |                                |
| Prime Boost Pump On         |            |         |             |               |        |       |      |             |      |       |          |   |  |  |                                |
| Fuel Boost Pressure low     |            |         |             |               |        |       |      |             |      |       |          |   |  |  |                                |
|                             |            |         |             |               |        |       |      |             |      |       |          |   |  |  |                                |
| Engine Oil Temperature      | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |
| Engine Oil Temperature High | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |
| Engine Oil Pressure         | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |
| Engine Oil Pressure low     | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |
| Engine Oil Quantity         |            |         |             |               |        |       |      |             |      |       |          |   |  |  |                                |
| Engine Oil Quantity Low     |            |         |             |               |        |       |      |             |      |       |          |   |  |  |                                |
| Oil Filter Bypass           |            |         |             |               |        |       |      |             |      |       |          |   |  |  |                                |
| Engine Chip                 | X          |         |             |               |        |       |      |             |      |       |          | X                                       | X  |  |                                |

TABLE 14. CONTINUED.

| PARAMETER                             | PRIORITIES                                      | MISSION PHASE                                  | ENVIRONMENT                                   | DISPLAY                                   | FORMAT   | RE-<br>PONSE                             | FEED<br>BACK           |
|---------------------------------------|---|--|---|---|--|--|------------------------|
|                                       | SAFETY<br>MISSION<br>MAINTENANCE<br>UNNECESSARY | TAKEOFF<br>CRUISE<br>HOVER<br>LAND<br>SHUTDOWN | NIGHT<br>DAY<br>VMC<br>IMC<br>MOC<br>ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESTROYABLE<br>AUTO NOT DESTROYABLE | DISPLAY<br>UNNECESSARY |
| TIT                                   |   |  |   |   |  |  |                        |
| EGI                                   | X   |  |   | X   | X  |  |                        |
| N <sub>P</sub>                        |   |  |   |   |  |  |                        |
| Inlet Air Pressure Negative           |   |  |   |   |  |  |                        |
| N <sub>9</sub>                        | X   |  |   | X   | X  |  |                        |
| Engine Out                            |   |  |   |   |  |  |                        |
| N <sub>1</sub> Control Loop Energized | X   |  |   | X   | X  |  |                        |
| XMSN Oil Pressure                     | X   |  |   | X   | X  |  |                        |
| XMSN Oil Pressure Low                 | X   |  |   | X   | X  |  |                        |
| XMSN Oil Temperature                  | X   |  |   | X   | X  |  |                        |
| XMSN Oil Temperature High             | X   |  |   | X   | X  |  |                        |
| Chip Main XMSN                        | X   |  |   | X   | X  |  |                        |
| Chip Int XMSN                         |   |  |   |   |  |  |                        |
| Chip Tail XMSN                        |   |  |   |   |  |  |                        |
| XMSN Oil Bypass                       |   |  |   |   |  |  |                        |

TABLE 14. CONTINUED.

| PARAMETER                         | PRIORITIES |         |             | MISSION PHASE |        |       | ENVIRONMENT |    |     | DISPLAY | FORMAT | RE-<br>PORSE  |                   | FEEL<br>BACK |
|-----------------------------------|------------|---------|-------------|---------------|--------|-------|-------------|----|-----|---------|--------|---------------|-------------------|--------------|
|                                   | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | ALTITUDE    | IN | OUT |         |        | AUTO DESTABLE | AUTO NOT DESTABLE |              |
| $N_H$                             | X          |         |             |               |        |       |             |    |     | X       |        | X             |                   |              |
| Main Rotor Overspeed              |            |         |             |               |        |       |             |    |     | X       |        | X             |                   |              |
| Low Rotor RPM                     |            |         |             |               |        |       |             |    |     | X       |        | X             |                   |              |
|                                   |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
| % Torque                          | X          |         |             |               |        |       |             |    |     | X       |        | X             |                   |              |
|                                   |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
| Primary Servo Pressure Low        |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
| Hydraulic Pump Pressure Low       |            | X       |             |               |        |       |             |    |     | X       |        | X             |                   |              |
| Primary Servo Jam                 |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
| Boost Servo Jam                   |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
| Boost Servo Pressure Low          |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
| Tail Rotor Servo Pressure Low     |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
| Backup Pump On                    |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
| Flight Control Hydraulic Pressure | X          |         |             |               |        |       |             |    |     | X       |        | X             |                   |              |
| Utility Hydraulic Pressure        | X          |         |             |               |        |       |             |    |     | X       |        | X             |                   |              |
|                                   |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |
|                                   |            |         |             |               |        |       |             |    |     |         |        |               |                   |              |

TABLE 14. CONTINUED.

| PARAMETER                    | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY |          | FORMAT    |               | RE-<br>PONSE |              | FEED-<br>BACK |          |         |          |               |                   |         |             |
|------------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|-----------|---------------|--------------|--------------|---------------|----------|---------|----------|---------------|-------------------|---------|-------------|
|                              | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | WVC | JRC | MODE    | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY  | QUANTITATIVE | QUALITATIVE   | COMBINED | CAUTION | ADVISORY | AUTO DESTABLE | AUTO NOT DESTABLE | DISPLAY | UNNECESSARY |
| APU Exhaust Temperature High |            | X       |             |               |        |       |      |             |     |     |     |         |          | X         |               |              |              |               |          | X       | X        |               |                   | X       |             |
| APU Oil Pressure Low         |            | X       |             |               |        |       |      |             |     |     |     |         |          | X         |               |              |              |               |          | X       | X        |               |                   | X       |             |
| APU Overspeed                |            | X       |             |               |        |       |      |             |     |     |     |         |          | X         |               |              |              |               |          | X       | X        |               |                   | X       |             |
| APU Underspeed               |            | X       |             |               |        |       |      |             |     |     |     |         |          | X         |               |              |              |               |          | X       | X        |               |                   | X       |             |
| APU Sequence Fail            |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| APU Fire                     |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| APU Generator On             |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| APU On                       |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| APU Tachometer               |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
|                              |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
|                              |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Generator Output             |            | X       |             |               |        |       |      |             |     |     |     |         |          | X         |               |              |              | X             |          |         |          |               |                   |         |             |
| AC Inverter Output low       |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Converter Output low         |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Rectifier Off                |            | X       |             |               |        |       |      |             |     |     |     |         |          | X         |               |              |              | X             |          |         |          |               |                   |         |             |
| Battery low Charge           |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Battery fault                |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| AC Ess Bus Off               |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| DL Ess Bus Off               |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |

TABLE 14. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY |     | FORMAT       |             | RE-<br>PONSE | FEED-<br>BACK |
|----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|-----|--------------|-------------|--------------|---------------|
|                            | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | WVC | WIC | WOC     | WOC | QUANTITATIVE | QUALITATIVE |              |               |
| AC Load Meter              | X          |         |             |               |        |       |      |             |     |     |     |         | X   |              | X           |              |               |
| DC Load Meter              | X          |         |             |               |        |       |      |             |     |     |     |         | X   |              | X           |              |               |
| Engine Fire                | X          |         |             |               |        |       |      |             |     |     |     |         | X   |              | X           |              |               |
| Flt Path Stab Sys Fail     |            |         |             |               |        |       |      |             |     |     |     |         |     |              | X           |              |               |
| Stabilator Auto Mode In Op |            |         |             |               |        |       |      |             |     |     |     |         |     |              |             |              |               |
| Stabilator Position        |            |         |             |               |        |       |      |             |     |     |     |         |     |              |             |              |               |
| SAS Off                    | X          |         |             |               |        |       |      |             |     |     |     |         | X   |              | X           |              |               |
| Pitch Bias Failure         |            |         |             |               |        |       |      |             |     |     |     |         |     |              |             |              |               |
| Gust Lock Not Disengaged   |            |         |             |               |        |       |      |             |     |     |     |         |     |              |             |              |               |

TABLE 14. CONTINUED.

| PARAMETER             | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY |          | FORMAT    | RE-<br>PONSE  | FEEL<br>BACK |              |             |          |         |          |                  |                      |         |             |
|-----------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|-----------|---------------|--------------|--------------|-------------|----------|---------|----------|------------------|----------------------|---------|-------------|
|                       | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | INTGT       | DAY | VNC | INC | NOE     | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY  | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTROYABLE | AUTO NOT DESTROYABLE | DISPLAY | UNNECESSARY |
| Eng. Anti-Ice On      |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
| Pilot Heat On         |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
| Heater On             |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
| Heater Hot            |            | X       |             |               |        |       |      |             |     |     |     |         |          |           | X             |              |              |             |          | X       |          |                  |                      |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
| Cargo Hook Open       |            | X       |             |               |        |       |      |             |     |     |     |         |          |           | X             |              |              |             |          | X       |          |                  |                      |         |             |
| Cargo Hook Armed      |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
| Wheel Dephased        |            | X       |             |               |        |       |      |             |     |     |     |         |          |           | X             |              |              |             | X        |         |          |                  |                      |         |             |
| Parking Brake On      |            | X       |             |               |        |       |      |             |     |     |     |         |          |           | X             |              |              |             |          | X       |          |                  |                      |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
| Eng. Start Valve Open |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |             |          |         |          |                  |                      |         |             |
| Master Caution        | X          |         |             |               |        |       |      |             |     |     |     |         |          |           | X             |              |              |             |          | X       |          |                  |                      |         |             |

TABLE 15. OH-58C INFORMATION REQUIREMENTS.

| PARAMETER                   | PRIORITIES |         |            | MISSION PHASE |        |       | ENVIRONMENT |     |     | DISPLAY | FORMAT | RE-<br>PONSE |             | FEED-<br>BACK |
|-----------------------------|------------|---------|------------|---------------|--------|-------|-------------|-----|-----|---------|--------|--------------|-------------|---------------|
|                             | SAFETY     | MISSION | WATERBORNE | TAKEOFF       | CRUISE | HOVER | NIGHT       | DAY | WVC | INC     | NO     | QUANTITATIVE | QUALITATIVE | DISP          |
| Fuel Quantity               | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |
| Fuel Low                    | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |
| Fuel Pressure               |            |         |            |               |        |       |             |     |     |         |        |              |             |               |
| Fuel Pressure Low           |            |         |            |               |        |       |             |     |     |         |        |              |             |               |
| Fuel Filter Obstructed      | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |
| Prime Boost Pump On         |            | X       |            |               |        |       |             |     |     |         |        |              | X           |               |
| Fuel Boost Pressure low     |            |         |            |               |        |       |             |     |     |         |        |              |             |               |
| Engine Oil Temperature      | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |
| Engine Oil Temperature High | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |
| Engine Oil Pressure         | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |
| Engine Oil Pressure low     | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |
| Engine Oil Quantity         |            |         |            |               |        |       |             |     |     |         |        |              |             |               |
| Engine Oil Quantity low     |            |         |            |               |        |       |             |     |     |         |        |              |             |               |
| Oil Filter Bypass           | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |
| Engine Chip                 | X          |         |            |               |        |       |             |     |     |         |        |              | X           |               |

TABLE 15. CONTINUED.

| PARAMETER                             | PRIORITIES |         |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  |          | FORMAT        |             | RE-<br>PONSE |             | FEED-<br>BACK |         |          |                 |                     |         |             |
|---------------------------------------|------------|---------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|----------|---------------|-------------|--------------|-------------|---------------|---------|----------|-----------------|---------------------|---------|-------------|
|                                       | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | HOE | ALTITUDE | CRITICAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED      | CAUTION | ADVISORY | AUTO DESTINABLE | AUTO NOT DESTINABLE | DISPLAY | UNNECESSARY |
| TIT                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |          |               |             |              |             |               |         |          |                 |                     |         |             |
| EGI (TOT)                             | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             | X            |             |               |         |          |                 |                     |         |             |
| N <sub>P</sub>                        | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             | X            |             |               |         |          |                 |                     |         |             |
| Inlet Air Pressure Negative           |            |         |             |               |        |       |      |          |             |     |     |     |     |          |          |               |             |              |             |               |         |          |                 |                     |         |             |
|                                       |            |         |             |               |        |       |      |          |             |     |     |     |     |          |          |               |             |              |             |               |         |          |                 |                     |         |             |
| N <sub>Q</sub>                        | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             | X            |             |               |         |          |                 |                     |         |             |
| Engine Out                            | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             |              | X           |               |         |          |                 |                     |         |             |
| N <sub>1</sub> Control Loop Energized |            |         |             |               |        |       |      |          |             |     |     |     |     |          |          |               |             |              |             |               |         |          |                 |                     |         |             |
|                                       |            |         |             |               |        |       |      |          |             |     |     |     |     |          |          |               |             |              |             |               |         |          |                 |                     |         |             |
|                                       |            |         |             |               |        |       |      |          |             |     |     |     |     |          |          |               |             |              |             |               |         |          |                 |                     |         |             |
| XMSN Oil Pressure                     | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             |              | X           |               |         |          |                 |                     |         |             |
| XMSN Oil Pressure Low                 | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             |              | X           |               |         |          |                 |                     |         |             |
| XMSN Oil Temperature                  | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             |              | X           |               |         |          |                 |                     |         |             |
| XMSN Oil Temperature High             | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             |              | X           |               |         |          |                 |                     |         |             |
| Chip Main XMSN                        | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             |              | X           |               |         |          |                 |                     |         |             |
| Chip Int XMSN                         | X          |         |             |               |        |       |      |          |             |     |     |     |     |          | X        |               |             |              | X           |               |         |          |                 |                     |         |             |
| Chip Tail XMSN                        |            |         |             |               |        |       |      |          |             |     |     |     |     |          |          |               |             |              |             |               |         |          |                 |                     |         |             |
| XMSN Oil Bypass                       |            |         |             |               |        |       |      |          |             |     |     |     |     |          |          |               |             |              |             |               |         |          |                 |                     |         |             |

TABLE 15. CONTINUED.

| PARAMETER                         | PRIORITIES |         |                            | MISSION PHASE |        |       | ENVIRONMENT |     |     | DISPLAY |     | FORMAT  |  | RE-<br>PONSE |             | FEED-<br>BACK |         |          |                  |                      |         |             |
|-----------------------------------|------------|---------|----------------------------|---------------|--------|-------|-------------|-----|-----|---------|-----|---------|--|--------------|-------------|---------------|---------|----------|------------------|----------------------|---------|-------------|
|                                   | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | NIGHT       | DAY | WNC | INC     | NOE | ALITUDE | CRITICAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED      | CAUTION | ADVISORY | AUTO DESTROYABLE | AUTO NOT DESTROYABLE | DISPLAY | UNNECESSARY |
| N <sub>H</sub>                    | X          |         |                            |               |        |       |             |     |     |         |     |         | X  | X            |             |               |         |          |                  |                      |         |             |
| Main Rotor Overspeed              |            |         |                            |               |        |       |             |     |     |         |     |         | X  |              |             | X             |         |          |                  |                      |         |             |
| Low Rotor RPM                     |            |         |                            |               |        |       |             |     |     |         |     |         | X  |              |             | X             |         |          |                  |                      |         |             |
|                                   |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| ± Torque                          | X          |         |                            |               |        |       |             |     |     |         |     |         | X  |              |             | X             |         |          |                  |                      |         |             |
|                                   |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| Primary Servo Pressure Low        |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| Hydraulic Pump Pressure low       | X          |         |                            |               |        |       |             |     |     |         |     |         | X  |              |             | X             |         |          |                  |                      |         |             |
| Primary Servo Jam                 |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| Boost Servo Jam                   |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| Boost Servo Pressure Low          |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| Tail Rotor Servo Pressure Low     |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| Backup Pump On                    |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| Flight Control Hydraulic Pressure |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
| Utility Hydraulic Pressure        |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
|                                   |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |
|                                   |            |         |                            |               |        |       |             |     |     |         |     |         |  |              |             |               |         |          |                  |                      |         |             |

TABLE 15. CONTINUED.

| PARAMETER                    | PRIORITIES |         |             | MISSION PHASE |        |       | ENVIRONMENT |     |     | DISPLAY | FORMAT   | RE-<br>PONSE | FEED-<br>BACK |             |              |             |          |         |          |                 |                     |         |                     |
|------------------------------|------------|---------|-------------|---------------|--------|-------|-------------|-----|-----|---------|----------|--------------|---------------|-------------|--------------|-------------|----------|---------|----------|-----------------|---------------------|---------|---------------------|
|                              | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | NOVOR | RIGHT       | DAY | INC | INC     | ALTITUDE | CORRUPT      | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTINABLE | AUTO NOT DESTINABLE | DISPLAY | DISPLAY UNNECESSARY |
| APU Exhaust Temperature High |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Oil Pressure Low         |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Overspeed                |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Underspeed               |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Sequence Fail            |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Fire                     |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Generator On             |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU On                       |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Tachometer               |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
|                              |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| Generator Output             |            | X       |             |               |        |       |             |     |     |         |          |              | X             |             |              |             | X        |         |          |                 |                     |         |                     |
| AC Inverter Output low       |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| Converter Output low         |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| Rectifier Off                |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| Battery low Charge           |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| Battery Fault                |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| AC ESS Bus Off               |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |
| DC ESS Bus Off               |            |         |             |               |        |       |             |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |                     |

TABLE 15. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             | MISSION PHASE |        |       |          | ENVIRONMENT   |     |     |     | DISPLAY                                   | FORMAT   | RE-<br>PONSE                           | FEED-<br>BACK                  |
|----------------------------|------------|---------|-------------|---------------|--------|-------|----------|---------------|-----|-----|-----|---|--|--|--------------------------------|
|                            | SAFETY     | MISSION | MAINTENANCE | TAKOFF        | CRUISE | HOVER | LAND     | INTER-<br>DAY | PHC | PHC | PHC |   |  |  |                                |
|                            |            |         | UNNECESSARY |               |        |       | SHUTDOWN |               |     |     |     | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESTINABLE<br>AUTO NOT DESTINABLE | DISPLAY<br>DISPLAY UNNECESSARY |
| AC Load Meter              |            |         |             |               |        |       |          |               |     |     |     |   |  |  |                                |
| DC Load Meter              | X          |         |             |               |        |       |          |               |     |     |     | X   | X  |  |                                |
| Engine Fire                |            |         |             |               |        |       |          |               |     |     |     |   |  |  |                                |
| Flt Path Stab Sys Fail     |            |         |             |               |        |       |          |               |     |     |     |   |  |  |                                |
| Stabilator Auto Mode In Op |            |         |             |               |        |       |          |               |     |     |     |   |  |  |                                |
| Stabilator Position        |            |         |             |               |        |       |          |               |     |     |     |   |  |  |                                |
| SAS Off                    |            |         |             |               |        |       |          |               |     |     |     |   |  |  |                                |
| Pitch Bias Failure         |            |         |             |               |        |       |          |               |     |     |     |   |  |  |                                |
| Gust Lock Not Disengaged   |            |         |             |               |        |       |          |               |     |     |     |   |  |  |                                |
| IFF In Oper at Eve         | X          |         |             |               |        |       |          |               |     |     |     | X   | X  |  |                                |

TABLE 15. CONTINUED.

| PARAMETER             | PRIORITIES |         |                            | MISSION PHASE |        |       |      | ENVIRONMENT |        |     |       | DISPLAY | FORMAT | RE-<br>PONSE | FEED-<br>BACK |               |             |              |             |          |         |          |                  |                      |         |             |
|-----------------------|------------|---------|----------------------------|---------------|--------|-------|------|-------------|--------|-----|-------|---------|--------|--------------|---------------|---------------|-------------|--------------|-------------|----------|---------|----------|------------------|----------------------|---------|-------------|
|                       | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHOOTDOWN   | INTENT | DAY | NIGHT | INC     | NOE    | ALTITUDE     | CONTINUOUS    | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTROYABLE | AUTO NOT DESTROYABLE | DISPLAY | UNNECESSARY |
| Eng. Anti-Ice On      |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
|                       |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
| Pilot Heat On         |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
|                       |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
| Heater On             |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
| Heater Hot            |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
|                       |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
| Cargo Hook Open       |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
| Cargo Hook Armed      |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
|                       |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
| Parking Brake On      |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
|                       |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
| Eng. Start Valve Open |            |         |                            |               |        |       |      |             |        |     |       |         |        |              |               |               |             |              |             |          |         |          |                  |                      |         |             |
| Master Caution        | X          |         |                            |               |        |       |      |             |        |     |       |         |        |              |               | X             |             |              |             | X        |         |          |                  |                      |         |             |

TABLE 16. AH-1G INFORMATION REQUIREMENTS.

| PARAMETER                   | PRIORITIES |         |             | MISSION PHASE |        |       | ENVIRONMENT |     |     | DISPLAY | FORMAT    | RE-<br>PRIORISE                           | FEED-<br>BACK  |                                    |                                |
|-----------------------------|------------|---------|-------------|---------------|--------|-------|-------------|-----|-----|---------|-----------|---|--|------------------------------------|--------------------------------|
|                             | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | DAY         | PHC | TWC | MODE    | ALTIMETER | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESTABLE<br>AUTO NOT DESTABLE | DISPLAY<br>DISPLAY UNNECESSARY |
| Fuel Quantity               | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Fuel Low                    | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Fuel Pressure               | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Fuel Pressure Low           | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Fuel Filter Obstructed      | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Prime Boost Pump On         | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Fuel Boost Pressure Low     |            | X       |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Governor Emergency          | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Engine Oil Temperature      | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Engine Oil Temperature High | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Engine Oil Pressure         | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Engine Oil Pressure Low     | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Engine Oil Quantity         |            |         |             |               |        |       |             |     |     |         |           |   |  |                                    |                                |
| Engine Oil Quantity Low     |            |         |             |               |        |       |             |     |     |         |           |   |  |                                    |                                |
| Oil Filter Bypass           | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |
| Engine Chip                 | X          |         |             |               |        |       |             |     |     |         |           | X   | X  |                                    |                                |

TABLE 16. CONTINUED.

| PARAMETER                             | PRIORITIES |         |                            | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY | FORMAT   | RE-<br>PONSE | FEED-<br>BACK |             |              |             |          |         |          |               |                   |         |             |
|---------------------------------------|------------|---------|----------------------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|--------------|---------------|-------------|--------------|-------------|----------|---------|----------|---------------|-------------------|---------|-------------|
|                                       | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | INTIGHT     | DAY | WVC | INC | NOE     | ALTITUDE | CONTINUAL    | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTABLE | AUTO NOT DESTABLE | DISPLAY | UNNECESSARY |
| TIT                                   |            |         |                            |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| EGT                                   | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| N <sub>p</sub>                        | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| Inlet Air Pressure Negative           | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
|                                       |            |         |                            |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| N <sub>g</sub>                        | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| Engine Out                            |            |         |                            |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| N <sub>1</sub> Control Loop Energized |            |         |                            |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
|                                       |            |         |                            |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| XMSN Oil Pressure                     | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| XMSN Oil Pressure Low                 | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| XMSN Oil Temperature                  |            |         |                            |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| XMSN Oil Temperature High             | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| Chip Main XMSN                        | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| Chip Int XMSN                         | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| Chip Tail XMSN                        | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |
| XMSN Oil Bypass                       | X          |         |                            |               |        |       |      |             |     |     |     |         |          |              | X             |             |              | X           |          |         |          |               |                   |         |             |

TABLE 16. CONTINUED.

| PARAMETER                         | PRIORITIES |         |             | MISSION PHASE |        |       | ENVIRONMENT |          |        | DISPLAY | FORMAT | RE-<br>POUSE | FEED-<br>BACK |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
|-----------------------------------|------------|---------|-------------|---------------|--------|-------|-------------|----------|--------|---------|--------|--------------|---------------|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|-----------------|---------------------|---------|-------------|
|                                   | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND        | SHUTDOWN | INTERL | DAY     | VNC    | INC          | MODE          | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO RESTORABLE | AUTO NOT RESTORABLE | DISPLAY | UNNECESSARY |
| N <sub>H</sub>                    | X          |         |             |               |        |       |             |          |        |         |        |              |               |          | X         |               |             | X            |             |          |         |          |                 |                     |         |             |
| Main Rotor Overspeed              | X          |         |             |               |        |       |             |          |        |         |        |              |               |          | X         |               |             |              | X           |          |         |          |                 |                     |         |             |
| Low Rotor RPM                     | X          |         |             |               |        |       |             |          |        |         |        |              |               |          | X         |               |             |              | X           |          |         |          |                 |                     |         |             |
|                                   |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| % Torque                          | X          |         |             |               |        |       |             |          |        |         |        |              |               |          | X         |               |             |              | X           |          |         |          |                 |                     |         |             |
|                                   |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| Primary Servo Pressure Low        |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| Hydraulic Pump Pressure Low       |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| Primary Servo Jam                 |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| Boost Servo Jam                   |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| Boost Servo Pressure Low          |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| Tail Rotor Servo Pressure Low     |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| Backup Pump On                    |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
| Flight Control Hydraulic Pressure | X          |         |             |               |        |       |             |          |        |         |        |              |               |          | X         |               |             |              | X           |          |         |          |                 |                     |         |             |
| Utility Hydraulic Pressure        |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |
|                                   |            |         |             |               |        |       |             |          |        |         |        |              |               |          |           |               |             |              |             |          |         |          |                 |                     |         |             |

TABLE 16. CONTINUED.

| PARAMETER                    | PRIORITIES |         |             | MISSION PHASE |        |       | ENVIRONMENT |     |     | DISPLAY | FORMAT | RE-<br>PONSE | FEED-<br>BACK |               |             |              |             |          |         |          |                 |                     |         |                     |
|------------------------------|------------|---------|-------------|---------------|--------|-------|-------------|-----|-----|---------|--------|--------------|---------------|---------------|-------------|--------------|-------------|----------|---------|----------|-----------------|---------------------|---------|---------------------|
|                              | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | NIGHT       | DAY | W/C | INC     | NOE    | ALTITUDE     | CONTINUAL     | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTINABLE | AUTO NOT DESTINABLE | DISPLAY | DISPLAY UNNECESSARY |
| APU Exhaust Temperature High |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Oil Pressure Low         |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Overspeed                |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Underspeed               |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Sequence Fail            |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Fire                     |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Generator On             |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU On                       |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| APU Tachometer               |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
|                              |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
|                              |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| Generator Output             |            | X       |             |               |        |       |             |     |     |         |        |              |               | X             |             |              |             |          | X       |          |                 |                     |         |                     |
| AC Inverter Output low       |            | X       |             |               |        |       |             |     |     |         |        |              |               | X             |             |              |             |          | X       |          |                 |                     |         |                     |
| Converter Output Low         |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| Rectifier Off                |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| Battery low Charge           |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| Battery Fault                |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| AC ESS Bus Off               |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |
| DC Ess Bus Off               |            |         |             |               |        |       |             |     |     |         |        |              |               |               |             |              |             |          |         |          |                 |                     |         |                     |

TABLE 16. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY |          | FORMAT    | RE-<br>PONSE  | FEED-<br>BACK |              |             |          |         |          |               |                   |         |             |
|----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|-----------|---------------|---------------|--------------|-------------|----------|---------|----------|---------------|-------------------|---------|-------------|
|                            | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | VMC | JMC | MOE     | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY   | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTABLE | AUTO NOT DESTABLE | DISPLAY | UNNECESSARY |
| AC Load Meter              |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| DC Load Meter              | X          |         |             |               |        |       |      |             |     |     |     |         |          | X         |               |               |              |             | X        |         |          |               |                   |         |             |
|                            |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| Engine Fire                |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| Flt Path Stab Sys Fail     |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| Stabilator Auto Mode In Op |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| Stabilator Position        |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
|                            |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| SAS Off                    |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
|                            |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| Pitch Bias Failure         |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
|                            |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| Gust Lock Not Disengaged   |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
|                            |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |
| LFI In Operative           |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |               |              |             |          |         |          |               |                   |         |             |

TABLE 16. CONTINUED.

| PARAMETER             | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY | FORMAT   | RE-<br>PONSE | FEED<br>BACK  |             |              |             |          |         |          |                 |                     |         |             |
|-----------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|--------------|---------------|-------------|--------------|-------------|----------|---------|----------|-----------------|---------------------|---------|-------------|
|                       | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | WVC | IMC | MOE     | ALTITUDE | CONTINUAL    | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTINABLE | AUTO NOT DESTINABLE | DISPLAY | UNNECESSARY |
| Eng. Anti-Ice On      |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
| Pitot Heat On         |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
| Heater On             |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
| Heater Hot            |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
| Cargo Hook Open       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
| Cargo Hook Armed      |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
| Parking Brake On      |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
|                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
| Eng. Start Valve Open |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |                 |                     |         |             |
| Master Caution        | X          |         |             |               |        |       |      |             |     |     |     |         |          | X            |               |             |              |             | X        |         |          |                 |                     |         |             |

TABLE 17. UH-60A BASELINE INFORMATION REQUIREMENTS.

| PARAMETER                   | PRIORITIES |         |             |             |         | MISSION PHASE |       |      |          |       |     | ENVIRONMENT |     |     |          |           | DISPLAY       |             | FORMAT       |             |          |         |          |
|-----------------------------|------------|---------|-------------|-------------|---------|---------------|-------|------|----------|-------|-----|-------------|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                             | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF | CRUISE        | HOVER | LAND | SHUTDOWN | NIGHT | DAY | VMC         | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| Fuel Quantity               | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             | X        |         |          |
| Fuel Low                    | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             | X        |         |          |
| Fuel Pressure               | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |
| Fuel Pressure Low           | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |
| Fuel Filter Obstructed      | X          |         |             |             | X       | X             | X     | X    |          |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |
| Prime Boost Pump On         |            | X       |             |             | X       | X             | X     | X    |          |       |     |             |     |     |          |           | X             |             |              |             |          |         | X        |
| Fuel Boost Pressure Low     |            |         |             |             |         |               |       |      |          |       |     |             |     |     |          |           |               |             |              |             |          |         |          |
|                             |            |         |             |             |         |               |       |      |          |       |     |             |     |     |          |           |               |             |              |             |          |         |          |
|                             |            |         |             |             |         |               |       |      |          |       |     |             |     |     |          |           |               |             |              |             |          |         |          |
| Engine Oil Temperature      | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |
| Engine Oil Temperature High | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |
| Engine Oil Pressure         | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |
| Engine Oil Pressure Low     | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |
| Engine Oil Quantity         |            |         |             |             |         |               |       |      |          |       |     |             |     |     |          |           |               |             |              |             |          |         |          |
| Engine Oil Quantity Low     |            |         |             |             |         |               |       |      |          |       |     |             |     |     |          |           |               |             |              |             |          |         |          |
| Oil Filter Bypass           | X          |         |             |             | X       | X             | X     | X    | X        |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |
| Engine Chip                 | X          |         |             |             | X       | X             | X     | X    |          |       |     |             |     |     |          |           | X             |             |              |             |          | X       |          |

TABLE 17. CONTINUED.

| PARAMETER                             | PRIORITIES MISSION PHASE |         |                            |         |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  |           | FORMAT                       |              |             |          |         |          |
|---------------------------------------|--------------------------|---------|----------------------------|---------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|------------------------------|--------------|-------------|----------|---------|----------|
|                                       | SAFETY                   | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| TIT                                   | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             | X        |         |          |
| EGT                                   |                          |         |                            |         |        |       |      |          |             |     |     |     |     |          |           |                              |              |             |          |         |          |
| N <sub>p</sub>                        | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             | X        |         |          |
| Inlet Air Pressure Negative           |                          |         |                            |         |        |       |      |          |             |     |     |     |     |          |           |                              |              |             |          |         |          |
|                                       |                          |         |                            |         |        |       |      |          |             |     |     |     |     |          |           |                              |              |             |          |         |          |
| N <sub>g</sub>                        | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             | X        |         |          |
| Engine Out                            | X                        |         |                            |         | X      | X     | X    |          |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |
| N <sub>1</sub> Control Loop Energized |                          |         |                            |         |        |       |      |          |             |     |     |     |     |          |           |                              |              |             |          |         |          |
|                                       |                          |         |                            |         |        |       |      |          |             |     |     |     |     |          |           |                              |              |             |          |         |          |
| XMSN Oil Pressure                     | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |
| XMSN Oil Pressure Low                 | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |
| XMSN Oil Temperature                  | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |
| XMSN Oil Temperature High             | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |
| Chip Main XMSN                        | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |
| Chip Int XMSN                         | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |
| Chip Tail XMSN                        | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |
| XMSN Oil Bypass                       | X                        |         |                            | X       | X      | X     | X    | X        |             |     |     |     |     |          |           | X                            |              |             |          | X       |          |

TABLE 17. CONTINUED.

| PARAMETER                         | PRIORITIES MISSION PHASE |         |             |             |         |        |       |      |          | ENVIRONMENT |       |     |     |     | DISPLAY |          | FORMAT |           |               |             |  |              |             |          |         |          |
|-----------------------------------|--------------------------|---------|-------------|-------------|---------|--------|-------|------|----------|-------------|-------|-----|-----|-----|---------|----------|--------|-----------|---------------|-------------|--|--------------|-------------|----------|---------|----------|
|                                   | SAFETY                   | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN |             | NIGHT | DAY | VMC | IMC | NOE     | ALTITUDE |        | CONTINUAL | CRITICAL ONLY | ACCESS ONLY |  | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| N <sub>R</sub>                    | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  | X            |             |          |         |          |
| Main Rotor Overspeed              | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  | X            |             |          |         |          |
| Low Rotor RPM                     | X                        |         |             |             | X       | X      | X     | X    |          |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |
|                                   |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
|                                   |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| % Torque                          | X                        |         |             |             | X       | X      | X     |      |          |             |       |     |     |     |         |          |        |           | X             |             |  |              |             | X        |         |          |
|                                   |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
|                                   |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Primary Servo Pressure Low        | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |
| Hydraulic Pump Pressure Low       | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |
| Primary Servo Jam                 | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |
| Boost Servo Jam                   | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |
| Boost Servo Pressure Low          |                          | X       |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |
| Tail Rotor Servo Pressure Low     |                          | X       |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |
| Backup Pump On                    |                          | X       |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          |         | X        |
| Flight Control Hydraulic Pressure | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |
| Utility Hydraulic Pressure        | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             |          | X       |          |

TABLE 17. CONTINUED.

| PARAMETER                    | PRIORITIES MISSION PHASE |         |             |             |         |        |       | ENVIRONMENT |          |  |       |     | DISPLAY |     | FORMAT |          |           |               |             |              |             |          |         |          |
|------------------------------|--------------------------|---------|-------------|-------------|---------|--------|-------|-------------|----------|--|-------|-----|---------|-----|--------|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                              | SAFETY                   | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND        | SHUTDOWN |  | NIGHT | DAY | VMC     | IMC | MOE    | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| APU Exhaust Temperature High |                          |         |             |             |         |        |       |             |          |  |       |     |         |     |        |          |           |               |             |              |             |          |         |          |
| APU Oil Pressure Low         |                          |         | X           | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          |         | X        |
| APU Overspeed                |                          |         | X           | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          |         | X        |
| APU Underspeed               |                          |         | X           | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          |         | X        |
| APU Sequence Fail            |                          |         | X           | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             | X        |         |          |
| APU Fire                     | X                        |         |             | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             | X        |         |          |
| APU Generator On             |                          | X       |             | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          |         | X        |
| APU On                       |                          | X       |             | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          |         | X        |
| APU Tachometer               |                          |         |             |             |         |        |       |             |          |  |       |     |         |     |        |          |           |               |             |              |             |          |         |          |
|                              |                          |         |             |             |         |        |       |             |          |  |       |     |         |     |        |          |           |               |             |              |             |          |         |          |
|                              |                          |         |             |             |         |        |       |             |          |  |       |     |         |     |        |          |           |               |             |              |             |          |         |          |
| Generator Output             |                          | X       |             | X           | X       | X      | X     | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          | X       |          |
| AC Inverter Output Low       |                          |         |             |             |         |        |       |             |          |  |       |     |         |     |        |          |           |               |             |              |             |          |         |          |
| Converter Output Low         |                          | X       |             | X           | X       | X      | X     | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          | X       |          |
| Rectifier Off                |                          |         |             |             |         |        |       |             |          |  |       |     |         |     |        |          |           |               |             |              |             |          |         |          |
| Battery Low Charge           |                          |         | X           | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          | X       |          |
| Battery Fault                |                          |         | X           | X           | X       | X      | X     | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          | X       |          |
| AC ESS Bus Off               | X                        |         |             | X           | X       | X      | X     | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          | X       |          |
| DC Ess Bus Off               | X                        |         |             | X           | X       | X      | X     | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          | X       |          |
| External Power Connected     |                          | X       |             | X           |         |        |       | X           |          |  |       |     |         |     |        |          |           | X             |             |              |             |          |         | X        |

TABLE 17. CONTINUED.

| PARAMETER                  | PRIORITIES MISSION PHASE |         |             |             |         |        |       |      |          | ENVIRONMENT |       |     |     |     |     | DISPLAY  |           |               | FORMAT      |  |              |             |          |         |          |
|----------------------------|--------------------------|---------|-------------|-------------|---------|--------|-------|------|----------|-------------|-------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--|--------------|-------------|----------|---------|----------|
|                            | SAFETY                   | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN |             | NIGHT | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY |  | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| AC Load Meter              |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |     |          |           |               |             |  |              |             |          |         |          |
| DC Load Meter              |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |     |          |           |               |             |  |              |             |          |         |          |
|                            |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |     |          |           |               |             |  |              |             |          |         |          |
| Engine Fire                | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |     |          |           | X             |             |  |              |             |          |         | X        |
| Flt Path Stab Sys Fail     | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |     |          |           | X             |             |  |              |             |          |         | X        |
| Stabilator Auto Mode In Op | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |     |          |           | X             |             |  |              |             |          |         | X        |
| Stabilator Position        | X                        |         |             |             | X       | X      | X     | X    |          |             |       |     |     |     |     |          |           | X             |             |  |              | X           |          |         |          |
|                            |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |     |          |           |               |             |  |              |             |          |         |          |
| SAS Off                    | X                        |         |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |     |          |           | X             |             |  |              |             |          |         | X        |
|                            |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |     |          |           |               |             |  |              |             |          |         |          |
| Pitch Bias Failure         |                          | X       |             |             | X       | X      | X     | X    | X        |             |       |     |     |     |     |          |           | X             |             |  |              |             |          |         | X        |
|                            |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |     |          |           |               |             |  |              |             |          |         |          |
| Gust Lock Not Disengaged   |                          | X       |             |             | X       |        |       |      | X        |             |       |     |     |     |     |          |           | X             |             |  |              |             |          |         | X        |
|                            |                          |         |             |             |         |        |       |      |          |             |       |     |     |     |     |          |           |               |             |  |              |             |          |         |          |
| IFF In-Operative           |                          | X       |             |             | X       | X      | X     | X    |          |             |       |     |     |     |     |          |           | X             |             |  |              |             |          |         | X        |

TABLE 17. CONTINUED.

| PARAMETER             | PRIORITIES MISSION PHASE |         |             |             |         |        |       |      | ENVIRONMENT |       |     |     |     |     | DISPLAY  |           | FORMAT        |             |              |             |          |         |          |
|-----------------------|--------------------------|---------|-------------|-------------|---------|--------|-------|------|-------------|-------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                       | SAFETY                   | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| Eng. Anti-Ice On      | X                        |         |             |             | X       | X      | X     |      |             |       |     |     |     |     |          |           | X             |             |              |             |          |         | X        |
|                       |                          |         |             |             |         |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Pitot Heat On         | X                        |         |             |             | X       | X      | X     | X    |             |       |     |     |     |     |          |           | X             |             |              |             |          |         | X        |
|                       |                          |         |             |             |         |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Heater On             |                          |         |             |             |         |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Heater Hot            |                          |         |             |             |         |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                       |                          |         |             |             |         |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Cargo Hook Open       | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              |             |          |         | X        |
| Cargo Hook Armed      | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              |             |          |         | X        |
|                       |                          |         |             |             |         |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Parking Brake On      | X                        |         |             |             | X       |        |       | X    | X           |       |     |     |     |     |          |           | X             |             |              |             |          |         | X        |
|                       |                          |         |             |             |         |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Eng. Start Valve Open |                          | X       |             |             | X       |        |       |      |             |       |     |     |     |     |          |           | X             |             |              |             |          | X       |          |
| Master Caution        | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              |             |          | X       |          |

TABLE 18. CH-47C BASELINE INFORMATION REQUIREMENTS.

| PARAMETER                   | PRIORITIES MISSION PHASE |         |             |             |         |        |       |      | ENVIRONMENT |       |     |     |     | DISPLAY |          | FORMAT    |               |             |              |             |          |         |          |
|-----------------------------|--------------------------|---------|-------------|-------------|---------|--------|-------|------|-------------|-------|-----|-----|-----|---------|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                             | SAFETY                   | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | VMC | IMC | NOE     | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| Fuel Quantity               | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |         |          |           | X             |             |              |             | X        |         |          |
| Fuel Low                    | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |         |          |           | X             |             |              |             | X        |         |          |
| Fuel Pressure               | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |         |          |           | X             |             |              |             |          | X       |          |
| Fuel Pressure Low           |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Fuel Filter Obstructed      |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Prime Boost Pump On         |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Fuel Boost Pressure Low     |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
|                             |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
|                             |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Engine Oil Temperature      | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |         |          |           | X             |             |              | X           |          |         |          |
| Engine Oil Temperature High | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |         |          |           | X             |             |              | X           |          |         |          |
| Engine Oil Pressure         | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |         |          |           | X             |             |              | X           |          |         |          |
| Engine Oil Pressure Low     | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |         |          |           | X             |             |              | X           |          |         |          |
| Engine Oil Quantity         |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Engine Oil Quantity Low     |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Oil Filter Bypass           |                          |         |             |             |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Engine Chip                 | X                        |         |             |             | X       | X      | X     | X    | X           |       |     |     |     |         |          |           | X             |             |              | X           |          |         |          |

TABLE 18. CONTINUED.

| PARAMETER                             | PRIORITIES |         |             |             | MISSION PHASE |        |       |      | ENVIRONMENT |       |     |     |     | DISPLAY | FORMAT   |           |               |             |              |             |          |         |          |
|---------------------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|-------------|-------|-----|-----|-----|---------|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                                       | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | VMC | IMC | NOE     | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| TIT                                   |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| EGT                                   | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             |              | X           |          |         |          |
| N <sub>p</sub>                        |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Inlet Air Pressure Negative           |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
|                                       |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| N <sub>g</sub>                        | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             |              | X           |          |         |          |
| Engine Out                            |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| N <sub>1</sub> Control Loop Energized | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             |              | X           |          |         |          |
|                                       |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| XMSN Oil Pressure                     | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             |              | X           |          |         |          |
| XMSN Oil Pressure Low                 | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             |              | X           |          |         |          |
| XMSN Oil Temperature                  | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             |              | X           |          |         |          |
| XMSN Oil Temperature High             | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             |              | X           |          |         |          |
| Chip Main XMSN                        | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             |              | X           |          |         |          |
| Chip Int XMSN                         |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| Chip Tail XMSN                        |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |
| XMSN Oil Bypass                       |            |         |             |             |               |        |       |      |             |       |     |     |     |         |          |           |               |             |              |             |          |         |          |

TABLE 18. CONTINUED.

| PARAMETER                         | PRIORITIES |         |             |             |  | MISSION PHASE |        |       |      |          | ENVIRONMENT |       |     |     |     | DISPLAY |          | FORMAT |           |               |             |  |              |             |          |         |          |
|-----------------------------------|------------|---------|-------------|-------------|--|---------------|--------|-------|------|----------|-------------|-------|-----|-----|-----|---------|----------|--------|-----------|---------------|-------------|--|--------------|-------------|----------|---------|----------|
|                                   | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY |  | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN |             | NIGHT | DAY | VMC | IMC | NOE     | ALTITUDE |        | CONTINUAL | CRITICAL ONLY | ACCESS ONLY |  | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| N <sub>R</sub>                    | X          |         |             |             |  | X             | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             | X        |         |          |
| Main Rotor Overspeed              |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Low Rotor RPM                     |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
|                                   |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
|                                   |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| % Torque                          | X          |         |             |             |  | X             | X      | X     |      |          |             |       |     |     |     |         |          |        |           | X             |             |  |              |             | X        |         |          |
|                                   |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
|                                   |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Primary Servo Pressure Low        |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Hydraulic Pump Pressure Low       |            | X       |             |             |  | X             | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             | X        |         |          |
| Primary Servo Jam                 |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Boost Servo Jam                   |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Boost Servo Pressure Low          |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Tail Rotor Servo Pressure Low     |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Backup Pump On                    |            |         |             |             |  |               |        |       |      |          |             |       |     |     |     |         |          |        |           |               |             |  |              |             |          |         |          |
| Flight Control Hydraulic Pressure | X          |         |             |             |  | X             | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             | X        |         |          |
| Utility Hydraulic Pressure        | X          |         |             |             |  | X             | X      | X     | X    | X        |             |       |     |     |     |         |          |        |           | X             |             |  |              |             | X        |         |          |

TABLE 18. CONTINUED.

| PARAMETER                    | PRIORITIES MISSION PHASE ENVIRONMENT |         |                            |         |        |       |      |          |       |     | DISPLAY |     | FORMAT |          |   |  |
|------------------------------|--------------------------------------|---------|----------------------------|---------|--------|-------|------|----------|-------|-----|---------|-----|--------|----------|---|--|
|                              | SAFETY                               | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT | DAY | VMC     | IMC | MOE    | ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY |
| APU Exhaust Temperature High |                                      | X       |                            | X       |        |       | X    |          |       |     |         |     |        |          | X   | X  |
| APU Oil Pressure Low         |                                      | X       |                            | X       |        |       | X    |          |       |     |         |     |        |          | X   | X  |
| APU Overspeed                |                                      | X       |                            | X       |        |       | X    |          |       |     |         |     |        |          | X   | X  |
| APU Underspeed               |                                      | X       |                            | X       |        |       | X    |          |       |     |         |     |        |          | X   | X  |
| APU Sequence Fail            |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| APU Fire                     |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| APU Generator On             |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| APU On                       |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| APU Tachometer               |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| Generator Output             |                                      | X       |                            | X       | X      | X     | X    | X        |       |     |         |     |        |          | X   | X  |
| AC Inverter Output Low       |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| Converter Output Low         |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| Rectifier Off                |                                      | X       |                            | X       | X      | X     | X    | X        |       |     |         |     |        |          | X   | X  |
| Battery Low Charge           |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| Battery Fault                |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| AC ESS Bus Off               |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |
| DC Ess Bus Off               |                                      |         |                            |         |        |       |      |          |       |     |         |     |        |          |   |  |

TABLE 18. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  | FORMAT    |               |             |              |             |          |         |          |
|----------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                            | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKOFF        | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | JMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| AC Load Meter              |            | X       |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             |          | X       |          |
| DC Load Meter              |            | X       |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             |          | X       |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Engine Fire                | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             |          | X       |          |
| Flt Path Stab Sys Fail     |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Stabilator Auto Mode In Op |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Stabilator Position        |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| SAS Off                    | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             |          | X       |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Pitch Bias Failure         |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Gust Lock Not Disengaged   |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| IFF In-Operative           |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |

TABLE 18. CONTINUED.

| PARAMETER             | PRIORITIES |         |             |             | MISSION PHASE |         |        |       |      | ENVIRONMENT |  |       |     |     | DISPLAY |     |          | FORMAT |           |               |             |  |              |             |          |         |          |
|-----------------------|------------|---------|-------------|-------------|---------------|---------|--------|-------|------|-------------|--|-------|-----|-----|---------|-----|----------|--------|-----------|---------------|-------------|--|--------------|-------------|----------|---------|----------|
|                       | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY |               | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN    |  | NIGHT | DAY | VMC | IMC     | NOE | ALTITUDE |        | CONTINUAL | CRITICAL ONLY | ACCESS ONLY |  | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| Eng. Anti-Ice On      |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
| Pitot Heat On         |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
| Heater On             |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
| Heater Hot            |            | X       |             |             |               | X       | X      | X     | X    | X           |  |       |     |     |         |     |          |        |           | X             |             |  |              |             |          | X       |          |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
| Cargo Hook Open       |            | X       |             |             |               | X       | X      | X     | X    | X           |  |       |     |     |         |     |          |        |           | X             |             |  |              |             |          | X       |          |
| Cargo Hook Armed      |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
| Wheel Dephased        |            | X       |             |             |               | X       |        |       | X    | X           |  |       |     |     |         |     |          |        |           | X             |             |  |              |             |          | X       |          |
| Parking Brake On      |            | X       |             |             |               | X       |        |       | X    | X           |  |       |     |     |         |     |          |        |           | X             |             |  |              |             |          |         | X        |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
|                       |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
| Eng. Start Valve Open |            |         |             |             |               |         |        |       |      |             |  |       |     |     |         |     |          |        |           |               |             |  |              |             |          |         |          |
| Master Caution        | X          |         |             |             |               | X       | X      | X     | X    | X           |  |       |     |     |         |     |          |        |           | X             |             |  |              |             |          | X       |          |

TABLE 19. OH-58C BASELINE INFORMATION REQUIREMENTS.

| PARAMETER                   | PRIORITIES |         |             |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  | FORMAT    |               |             |              |             |          |         |          |
|-----------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                             | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| Fuel Quantity               | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Fuel Low                    | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Fuel Pressure               |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Fuel Pressure Low           |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Fuel Filter Obstructed      | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Prime Boost Pump On         |            | X       |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Fuel Boost Pressure Low     |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                             |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                             |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Engine Oil Temperature      | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Engine Oil Temperature High | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Engine Oil Pressure         | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Engine Oil Pressure Low     | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Engine Oil Quantity         |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Engine Oil Quantity Low     |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Oil Filter Bypass           | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Engine Chip                 | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |

TABLE 19. CONTINUED.

| PARAMETER                             | PRIORITIES |         |             |             | MISSION PHASE |        |       |      | ENVIRONMENT |       |     |     |     |     | DISPLAY  |           | FORMAT        |             |              |             |
|---------------------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|-------------|-------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|
|                                       | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | VMC | YMC | NCE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE |
| TIT                                   |            |         |             |             |               |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |
| EGT                                   | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| N <sub>p</sub>                        | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| Inlet Air Pressure Negative           |            |         |             |             |               |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |
|                                       |            |         |             |             |               |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |
| N <sub>g</sub>                        | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| Engine Out                            | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| N <sub>1</sub> Control Loop Energized |            |         |             |             |               |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |
|                                       |            |         |             |             |               |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |
| XMSN Oil Pressure                     | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| XMSN Oil Pressure Low                 | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| XMSN Oil Temperature                  | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| XMSN Oil Temperature High             | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| Chip Main XMSN                        | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| Chip Int XMSN                         | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| Chip Tail XMSN                        | X          |         |             |             | X             | X      | X     | X    | X           |       |     |     |     |     |          |           | X             |             |              | X           |
| XMSN Oil Bypass                       |            |         |             |             |               |        |       |      |             |       |     |     |     |     |          |           |               |             |              |             |

TABLE 19. CONTINUED.

| PARAMETER                         | PRIORITIES MISSION PHASE ENVIRONMENT |         |             |             |         |        |       |      |          | DISPLAY |     |     | FORMAT |     |          |           |               |             |              |             |          |         |          |
|-----------------------------------|--------------------------------------|---------|-------------|-------------|---------|--------|-------|------|----------|---------|-----|-----|--------|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                                   | SAFETY                               | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT   | DAY | VMC | IMC    | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| N <sub>R</sub>                    | X                                    |         |             |             | X       | X      | X     | X    | X        |         |     |     |        |     |          |           | X             |             | X            |             |          |         |          |
| Main Rotor Overspeed              |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Low Rotor RPM                     |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
|                                   |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| % Torque                          | X                                    |         |             |             | X       | X      | X     |      |          |         |     |     |        |     |          |           | X             |             |              | X           |          |         |          |
|                                   |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Primary Servo Pressure Low        |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Hydraulic Pump Pressure Low       | X                                    |         |             |             | X       | X      | X     | X    | X        |         |     |     |        |     |          |           | X             |             |              |             |          | X       |          |
| Primary Servo Jam                 |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Boost Servo Jam                   |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Boost Servo Pressure Low          |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Tail Rotor Servo Pressure Low     |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Backup Pump On                    |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Flight Control Hydraulic Pressure |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |
| Utility Hydraulic Pressure        |                                      |         |             |             |         |        |       |      |          |         |     |     |        |     |          |           |               |             |              |             |          |         |          |

TABLE 19. CONTINUED.

| PARAMETER                    | PRIORITIES |         |                            | MISSION PHASE |        |       |      | ENVIRONMENT |       |     |     |     | DISPLAY |          | FORMAT                                    |              |             |                                 |
|------------------------------|------------|---------|----------------------------|---------------|--------|-------|------|-------------|-------|-----|-----|-----|---------|----------|---|--------------|-------------|---------------------------------|
|                              | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | VMC | IMC | MOE     | ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED<br>CAUTION<br>ADVISORY |
| APU Exhaust Temperature High |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| APU Oil Pressure Low         |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| APU Overspeed                |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| APU Underspeed               |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| APU Sequence Fail            |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| APU Fire                     |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| APU Generator On             |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| APU On                       |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| APU Tachometer               |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
|                              |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
|                              |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| Generator Output             |            | X       |                            |               | X      | X     | X    | X           |       |     |     |     |         |          | X   |              |             | X                               |
| AC Inverter Output Low       |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| Converter Output Low         |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| Rectifier Off                |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| Battery Low Charge           |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| Battery Fault                |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| AC ESS Bus Off               |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| DC Ess Bus Off               |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |
| External Power Connected     |            |         |                            |               |        |       |      |             |       |     |     |     |         |          |   |              |             |                                 |

TABLE 19. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  | FORMAT    |               |             |              |
|----------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|
|                            | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE |
| AC Load Meter              |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| DC Load Meter              | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |             | X            |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| Engine Fire                |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| Flt Path Stab Sys Fail     |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| Stabilator Auto Mode In Op |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| Stabilator Position        |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| SAS Off                    |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| Pitch Bias Failure         |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| Gust Lock Not Disengaged   |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |
| IFF In-Operative           |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |

TABLE 19. CONTINUED.

| PARAMETER             | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     |     | DISPLAY   |               | FORMAT       |             |          |         |
|-----------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|-----|-----------|---------------|--------------|-------------|----------|---------|
|                       | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | VMC | IMC | NOE | CONTINUAL | CRITICAL ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION |
| Eng. Anti-Ice On      |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
| Pitot Heat On         |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
| Heater On             |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
| Heater Hot            |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
| Cargo Hook Open       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
| Cargo Hook Armed      |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
| Parking Brake On      |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
|                       |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |
| Eng. Start Valve Open |            |         |             |               |        |       |      |             |     |     |     |     |           |               |              |             |          |         |

TABLE 20. AH-1G BASELINE INFORMATION REQUIREMENTS.

| PARAMETER                   | PRIORITIES |         |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  |           | FORMAT        |              |             |          |
|-----------------------------|------------|---------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|--------------|-------------|----------|
|                             | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | QUANTITATIVE | QUALITATIVE | COMBINED |
| Fuel Quantity               | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               | X            |             |          |
| Fuel Low                    | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               | X            |             |          |
| Fuel Pressure               | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Fuel Pressure Low           | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Fuel Filter Obstructed      | X          |         |             | X             | X      | X     | X    |          |             |     |     |     |     |          | X         |               |              | X           |          |
| Prime Boost Pump On         | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Fuel Boost Pressure Low     |            | X       |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Governor Emergency          | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Engine Oil Temperature      | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Engine Oil Temperature High | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Engine Oil Pressure         | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Engine Oil Pressure Low     | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Engine Oil Quantity         |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |              |             |          |
| Engine Oil Quantity Low     |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |              |             |          |
| Oil Filter Bypass           | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |
| Engine Chip                 | X          |         |             | X             | X      | X     | X    | X        |             |     |     |     |     |          | X         |               |              | X           |          |

TABLE 20. CONTINUED.

| PARAMETER                             | PRIORITIES |         |             |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  |           |               | FORMAT      |              |             |          |         |          |
|---------------------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                                       | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| TIT                                   |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| EGT                                   | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| N <sub>p</sub>                        | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Inlet Air Pressure Negative           | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             |          | X       |          |
|                                       |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                                       |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| N <sub>9</sub>                        | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Engine Out                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| N <sub>1</sub> Control Loop Energized |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                                       |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                                       |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| XMSN Oil Pressure                     | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| XMSN Oil Pressure Low                 | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| XMSN Oil Temperature                  |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| XMSN Oil Temperature High             | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Chip Main XMSN                        | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Chip Int XMSN                         | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| Chip Tail XMSN                        | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |
| XMSN Oil Bypass                       | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             | X        |         |          |

TABLE 20. CONTINUED.

| PARAMETER                         | PRIORITIES |         |             |             |         |        |       |      |          | MISSION PHASE |     |     |     |     |          | ENVIRONMENT |               |             |              |             |          | DISPLAY |          |  | FORMAT |  |  |  |
|-----------------------------------|------------|---------|-------------|-------------|---------|--------|-------|------|----------|---------------|-----|-----|-----|-----|----------|-------------|---------------|-------------|--------------|-------------|----------|---------|----------|--|--------|--|--|--|
|                                   | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT         | DAY | VMC | IMC | MOE | ALTITUDE | CONTINUAL   | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |  |        |  |  |  |
| N <sub>R</sub>                    | X          |         |             |             | X       | X      | X     | X    | X        |               |     |     |     |     |          |             | X             |             |              | X           |          |         |          |  |        |  |  |  |
| Main Rotor Overspeed              | X          |         |             |             | X       | X      | X     | X    | X        |               |     |     |     |     |          |             | X             |             |              | X           |          |         |          |  |        |  |  |  |
| Low Rotor RPM                     | X          |         |             |             | X       | X      | X     | X    | X        |               |     |     |     |     |          |             | X             |             |              |             |          | X       |          |  |        |  |  |  |
|                                   |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
|                                   |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| % Torque                          | X          |         |             |             | X       | X      | X     |      |          |               |     |     |     |     |          |             | X             |             |              |             | X        |         |          |  |        |  |  |  |
|                                   |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
|                                   |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| Primary Servo Pressure Low        |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| Hydraulic Pump Pressure Low       |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| Primary Servo Jam                 |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| Boost Servo Jam                   |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| Boost Servo Pressure Low          |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| Tail Rotor Servo Pressure Low     |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| Backup Pump On                    |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |
| Flight Control Hydraulic Pressure | X          |         |             |             | X       | X      | X     | X    | X        |               |     |     |     |     |          |             | X             |             |              |             | X        |         |          |  |        |  |  |  |
| Utility Hydraulic Pressure        |            |         |             |             |         |        |       |      |          |               |     |     |     |     |          |             |               |             |              |             |          |         |          |  |        |  |  |  |

TABLE 20. CONTINUED.

| PARAMETER                    | PRIORITIES |         |             |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  |           |               | FORMAT      |              |             |          |         |          |
|------------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                              | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | MOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| APU Exhaust Temperature High |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| APU Oil Pressure Low         |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| APU Overspeed                |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| APU Underspeed               |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| APU Sequence Fail            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| APU Fire                     |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| APU Generator On             |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| APU On                       |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| APU Tachometer               |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                              |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                              |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Generator Output             | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             |          |         | X        |
| AC Inverter Output Low       | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             |          |         | X        |
| Converter Output Low         |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Rectifier Off                |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Battery Low Charge           |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Battery Fault                |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| AC ESS Bus Off               |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| DC Ess Bus Off               |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |

TABLE 20. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  |           | FORMAT        |             |              |             |          |         |          |
|----------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|
|                            | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY |
| AC Load Meter              |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| DC Load Meter              | X          |         |             |             | X             | X      | X     | X    | X        |             |     |     |     |     |          |           | X             |             |              |             |          | X       |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Engine Fire                |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Flt Path Stab Sys Fail     |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Stabilator Auto Mode In Op |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Stabilator Position        |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| SAS Off                    |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Pitch Bias Failure         |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| Gust Lock Not Disengaged   |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
|                            |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |
| IFF In-Operative           |            |         |             |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |          |         |          |

TABLE 20. CONTINUED.

| PARAMETER             | PRIORITIES |         |             | MISSION PHASE |         |        |       |      | ENVIRONMENT |       |     |     |     | DISPLAY |          | FORMAT    |               |             |              |
|-----------------------|------------|---------|-------------|---------------|---------|--------|-------|------|-------------|-------|-----|-----|-----|---------|----------|-----------|---------------|-------------|--------------|
|                       | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY   | TAKEOFF | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | VMC | IMC | NOE     | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE |
| Eng. Anti-Ice On      |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
| Pitot Heat On         |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
| Heater On             |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
| Heater Hot            |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
| Cargo Hook Open       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
| Cargo Hook Armed      |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
| Parking Brake On      |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
|                       |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
| Eng. Start Valve Open |            |         |             |               |         |        |       |      |             |       |     |     |     |         |          |           |               |             |              |
| Master Caution        | X          |         |             |               | X       | X      | X     | X    | X           |       |     |     |     |         |          | X         |               |             | X            |

TABLE 21. SIKORSKY PILOT CONSENSUS.

| PARAMETER                   | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |       |     |     |     | DISPLAY | FORMAT   | RE-<br>PONSE | FEED-<br>BACK |             |              |             |          |         |          |                |                    |         |
|-----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-------|-----|-----|-----|---------|----------|--------------|---------------|-------------|--------------|-------------|----------|---------|----------|----------------|--------------------|---------|
|                             | SAFETY     | MISSION | MAINTENANCE | TAKOFF        | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | VMC | INC | NOE     | ALTITUDE | CONTINUAL    | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESIRABLE | AUTO NOT DESIRABLE | DISPLAY |
| Fuel Quantity               | X          |         |             | X             | X      | X     | X    |             | X     | X   | X   | X   | X       |          |              | X             |             | X            |             |          |         |          | X              |                    |         |
| Fuel Low                    | X          |         |             | X             | X      | X     | X    |             | X     | X   | X   | X   | X       |          | X            |               | X           |              |             |          |         |          | X              |                    |         |
| Fuel Pressure               |            |         | X           |               |        |       |      |             |       |     |     |     |         |          |              |               |             |              |             |          |         |          |                |                    |         |
| Fuel Pressure Low           | X          |         |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               | X           |              |             |          |         |          | X              |                    |         |
| Fuel Filter Obstructed      | X          |         |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               |             |              |             | X        |         |          | X              |                    |         |
| Prime Boost Pump On         |            | X       |             | X             | X      | X     | X    |             | X     | X   | X   | X   | X       |          | X            |               |             |              |             | X        |         |          | X              |                    |         |
| Fuel Boost Pressure low     | X          |         |             | X             | X      | X     | X    |             | X     | X   | X   | X   | X       |          | X            |               |             |              |             | X        |         |          | X              |                    |         |
|                             |            |         |             |               |        |       |      |             |       |     |     |     |         |          |              |               |             |              |             |          |         |          |                |                    |         |
| Engine Oil Temperature      | X          |         |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               |             |              | X           |          |         |          | X              |                    |         |
| Engine Oil Temperature High | X          |         |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               |             |              | X           |          |         |          | X              |                    |         |
| Engine Oil Pressure         | X          |         |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               |             |              | X           |          |         |          | X              |                    |         |
| Engine Oil Pressure low     | X          |         |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               |             |              | X           |          |         |          | X              |                    |         |
| Engine Oil Quantity         |            |         | X           |               |        |       |      |             |       |     |     |     |         |          |              |               |             |              |             |          |         |          |                |                    |         |
| Engine Oil Quantity Low     |            | X       |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               |             |              | X           |          |         |          | X              |                    |         |
| Oil Filter Bypass           | X          |         |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               |             |              | X           |          |         |          | X              |                    |         |
| Engne Chip                  | X          |         |             | X             | X      | X     | X    | X           | X     | X   | X   | X   | X       |          | X            |               |             |              | X           |          |         |          | X              |                    |         |
|                             |            |         |             |               |        |       |      |             |       |     |     |     |         |          |              |               |             |              |             |          |         |          |                |                    |         |
|                             |            |         |             |               |        |       |      |             |       |     |     |     |         |          |              |               |             |              |             |          |         |          |                |                    |         |

TABLE 21. CONTINUED.

| PARAMETER                             | PRIORITIES |         |                            | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  | FORMAT                                    | RE-<br>PONSE |             | FEED-<br>BACK                   |                                      |                        |
|---------------------------------------|------------|---------|----------------------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|---|--------------|-------------|---------------------------------|--------------------------------------|------------------------|
|                                       | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED<br>CAUTION<br>ADVISORY | AUTO DESIRABLE<br>AUTO NOT DESIRABLE | DISPLAY<br>UNNECESSARY |
| TIT                                   | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              |             | X                               | X                                    | X                      |
| EGT                                   |            |         | X                          |               |        |       |      |          |             |     |     |     |     |          |   |              | X           |                                 |                                      |                        |
| N <sub>p</sub>                        |            | X       |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   |          | X   | X            |             |                                 | X                                    |                        |
| Inlet Air Pressure Negative           |            |         | X                          |               |        |       |      |          |             |     |     |     |     |          |   |              |             |                                 |                                      |                        |
|                                       |            |         |                            |               |        |       |      |          |             |     |     |     |     |          |   |              |             |                                 |                                      |                        |
| N <sub>9</sub>                        | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   | X            |             |                                 | X                                    |                        |
| Engine Out                            | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    |                        |
| N <sub>1</sub> Control Loop Energized | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    | X                      |
|                                       |            |         |                            |               |        |       |      |          |             |     |     |     |     |          |   |              |             |                                 |                                      |                        |
| XMSN Oil Pressure                     | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   | X            |             |                                 | X                                    |                        |
| XMSN Oil Pressure Low                 | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    |                        |
| XMSN Oil Temperature                  | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    |                        |
| XMSN Oil Temperature High             | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    |                        |
| Chip Main XMSN                        | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    |                        |
| Chip Int XMSN                         | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    |                        |
| Chip Tail XMSN                        | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    |                        |
| XMSN Oil Bypass                       | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X   |              | X           |                                 | X                                    |                        |

TABLE 21. CONTINUED.

| PARAMETER                         | PRIORITIES                                      | MISSION PHASE                                  | ENVIRONMENT                                   | DISPLAY                                   | FORMAT   | RE-<br>PONSE                             | FEED-<br>BACK       |
|-----------------------------------|---|--|---|---|--|--|---------------------|
|                                   | SAFETY<br>MISSION<br>MAINTENANCE<br>UNNECESSARY | TAKEOFF<br>CRUISE<br>HOVER<br>LAND<br>SHUTDOWN | NIGHT<br>DAY<br>VNC<br>INC<br>MOE<br>ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESTROYABLE<br>AUTO NOT DESTROYABLE | DISPLAY UNNECESSARY |
| N <sub>R</sub>                    | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Main Rotor Overspeed              | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Low Rotor RPM                     | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
|                                   |   |  |   |   |  |  |                     |
| % Torque                          | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
|                                   |   |  |   |   |  |  |                     |
| Primary Servo Pressure Low        | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Hydraulic Pump Pressure Low       | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Primary Servo Jam                 | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Boost Servo Jam                   | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Boost Servo Pressure Low          | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Tail Rotor Servo Pressure Low     | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Backup Pump On                    | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Flight Control Hydraulic Pressure | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
| Utility Hydraulic Pressure        | X   | X X X X X                                      | X X X X X X                                   | X   | X  | X  |                     |
|                                   |   |  |   |   |  |  |                     |

TABLE 21. CONTINUED.

| PARAMETER                    | PRIORITIES |         |                            | MISSION PHASE |        |       |      | ENVIRONMENT |       |     |      |      | DISPLAY | FORMAT | RE-<br>PONSE |      | FEED-<br>BACK |
|------------------------------|------------|---------|----------------------------|---------------|--------|-------|------|-------------|-------|-----|------|------|---------|--------|--------------|------|---------------|
|                              | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | WIND | WAVE | WAVE    | WAVE   | WAVE         | WAVE | WAVE          |
| APU Exhaust Temperature High |            | X       |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| APU Oil Pressure Low         |            | X       |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| APU Overspeed                |            | X       |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| APU Underspeed               |            | X       |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| APU Sequence Fail            |            | X       |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| APU Fire                     | X          |         |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| APU Generator On             |            | X       |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| APU On                       |            | X       |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| APU Tachometer               |            |         | X                          | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |
| Generator Output             | X          |         |                            | X             | X      | X     | X    | X           | X     | X   | X    | X    | X       |        |              | X    | X             |
| AC Inverter Output Low       |            | X       |                            | X             | X      | X     | X    | X           | X     | X   | X    | X    | X       |        |              | X    | X             |
| Converter Output Low         |            | X       |                            | X             | X      | X     | X    | X           | X     | X   | X    | X    | X       |        |              | X    | X             |
| Rectifier Off                |            | X       |                            | X             | X      | X     | X    | X           | X     | X   | X    | X    | X       |        |              | X    | X             |
| Battery Low Charge           |            | X       |                            | X             | X      | X     | X    | X           | X     | X   | X    | X    | X       |        |              | X    | X             |
| Battery Fault                |            | X       |                            | X             | X      | X     | X    | X           | X     | X   | X    | X    | X       |        |              | X    | X             |
| AC ESS Bus Off               |            |         | X                          |               |        |       |      |             |       |     |      |      |         |        |              |      |               |
| DC Ess Bus Off               |            |         | X                          |               |        |       |      |             |       |     |      |      |         |        |              |      |               |
| External Power Connected     | X          |         |                            | X             |        |       | X    |             | X     | X   | X    | X    | X       |        |              | X    | X             |

TABLE 21. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY |          | FORMAT  |               | RE-<br>PONSE |             | FEED-<br>BACK |         |
|----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|---------|---------------|--------------|-------------|---------------|---------|
|                            | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | VMC | IMC | WTC     | ALTITUDE | CENTRAL | CRITICAL ONLY | QUANTITATIVE | QUALITATIVE | COMBINED      | CAUTION |
| AC Load Meter              |            |         | X           |               |        |       |      |             |     |     |     |         |          |         |               |              |             |               |         |
| DC Load Meter              |            |         | X           |               |        |       |      |             |     |     |     |         |          |         |               |              |             |               |         |
| Engine Fire                | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       |          | X       |               |              | X           | X             |         |
| Flt Path Stab Sys Fail     | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       |          | X       |               |              | X           | X             |         |
| Stabilator Auto Mode In Op | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       |          | X       |               |              | X           | X             |         |
| Stabilator Position        | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       |          | X       |               |              | X           | X             |         |
| SAS Off                    | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       |          | X       |               |              | X           | X             | X       |
| Pitch Bias Failure         | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       |          | X       |               |              | X           | X             |         |
| Gust Lock Not Disengaged   | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       |          |         |               |              | X           | X             |         |
| IFF In Operation           | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       |          | X       |               |              | X           | X             |         |

TABLE 21. CONTINUED.

| PARAMETER             | PRIORITIES  |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY | FORMAT   | RE-<br>PONSE  |              | FEED-<br>BACK      |
|-----------------------|-------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|---------------|--------------|--------------------|
|                       | SAFETY      | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | W/C | IMC | NOE     | ALTITUDE | CONTINUAL     | QUANTITATIVE | AUTO DESIRABLE     |
|                       | UNNECESSARY |         |             | SHUTDOWN      |        |       |      |             |     |     |     |         |          | CRITICAL ONLY | QUALITATIVE  | AUTO NOT DESIRABLE |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          | ACCESS ONLY   | COMBINED     |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               | CAUTION      |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               | ADVISORY     |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
| Eng. Anti-Ice On      | X           |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X             |              | X                  |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
| Pilot Heat On         | X           |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X             |              | X                  |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
| Heater On             |             |         | X           |               |        |       |      |             |     |     |     |         |          |               |              |                    |
| Heater Hot            |             | X       |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X             |              | X                  |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
| Cargo Hook Open       | X           |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X             |              | X                  |
| Cargo Hook Armed      | X           |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X             |              | X                  |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
| Parking Brake On      | X           |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X             |              | X                  |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
| Eng. Start Valve Open | X           |         |             | X             |        |       |      | X           | X   | X   | X   | X       | X        | X             |              | X                  |
|                       |             |         |             |               |        |       |      |             |     |     |     |         |          |               |              |                    |
|                       | X           |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X             |              | X                  |

TABLE 21. CONTINUED.

Additional Areas

Please answer the following questions:

Can you think of any other items of subsystem information that should be displayed in future helicopters?

Rate of change data during limit approach or exceedance.

Which caution/warning lights have you found illuminate most frequently?  
How frequently? During what conditions?

Chip Detectors

FPS/stabilator - due to SAS/FPS computer problems shutting system down

Electrical system

Are there any caution/warning lights that you have found to be unreliable?

Chip detectors

Fire warning

TABLE 21. CONTINUED.

What aspects of subsystem monitoring have you found to be most problematic, annoying, or distracting during NOE flight?

How do you feel about presenting information through voice warning systems or through beeps, tones, etc.?

Mixed reactions, from: "noise distracting" to "love it".

What problems do you see arising with systems that require you to push buttons to obtain information about subsystems?

TABLE 22. CH-47C PILOT CONSENSUS.

| PARAMETER                   | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY |          | FORMAT    |               | RE-<br>PONSE |              | FEED-<br>BACK |          |         |          |               |                   |         |             |
|-----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|-----------|---------------|--------------|--------------|---------------|----------|---------|----------|---------------|-------------------|---------|-------------|
|                             | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | WIND        | DAY | VMC | IMC | NOE     | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY  | QUANTITATIVE | QUALITATIVE   | COMBINED | CAUTION | ADVISORY | AUTO DESTABLE | AUTO NOT DESTABLE | DISPLAY | UNNECESSARY |
| Fuel Quantity               | X          |         |             | X             | X      | X     | X    |             | X   | X   | X   | X       | X        | X         |               | X            |              | X             |          |         |          |               | X                 |         |             |
| Fuel Low                    | X          |         |             | X             | X      | X     | X    |             | X   | X   | X   | X       | X        | X         |               | X            |              |               | X        |         |          |               | X                 |         |             |
| Fuel Pressure               |            |         | X           |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Fuel Pressure Low           | X          |         |             | X             | X      | X     | X    |             | X   | X   | X   | X       | X        | X         |               | X            |              |               | X        |         |          |               | X                 |         |             |
| Fuel Filter Obstructed      |            |         | X           |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Prime Boost Pump On         |            |         | X           |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Fuel Boost Pressure Low     | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X         |               | X            |              |               | X        |         |          |               | X                 |         |             |
|                             |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Engine Oil Temperature      | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X         |               | X            |              | X             |          |         |          |               | X                 |         |             |
| Engine Oil Temperature High | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X         |               | X            |              |               | X        |         |          |               | X                 |         |             |
| Engine Oil Pressure         | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X         |               |              |              | X             |          |         |          |               | X                 |         |             |
| Engine Oil Pressure Low     | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X         |               | X            |              |               | X        |         |          |               | X                 |         |             |
| Engine Oil Quantity         |            |         | X           |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Engine Oil Quantity Low     | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X         |               | X            |              |               | X        |         |          |               | X                 |         |             |
| Oil Filter Bypass           |            |         | X           |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
| Engine Chip                 | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X         |               | X            |              |               | X        |         |          |               | X                 |         |             |
|                             |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |
|                             |            |         |             |               |        |       |      |             |     |     |     |         |          |           |               |              |              |               |          |         |          |               |                   |         |             |

TABLE 22. CONTINUED.

| PARAMETER                    | PRIORITIES |         |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY                                   | FORMAT  | RE-<br>PONSE                                   | FEED-<br>BACK                  |
|------------------------------|------------|---------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|---|---|--|--------------------------------|
|                              | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | YMC | IMC | MOE |   |   |  |                                |
|                              |            |         | UNNECESSARY |               |        |       |      |          |             |     |     |     |     | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>CONTINUED<br>CAUTION<br>ADVISORY | AUTO DESTABILIZABLE<br>AUTO NOT DESTABILIZABLE | DISPLAY<br>DISPLAY UNNECESSARY |
| TIT                          | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X   | X   | X  |                                |
| EGT                          | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X   | X   | X  |                                |
| $P_p$                        |            |         | X           |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
| Inlet Air Pressure Negative  |            |         | X           |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
|                              |            |         |             |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
| $P_g$                        |            |         | X           |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
| Engine Out                   | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X   | X   | X  |                                |
| $N_1$ Control Loop Energized |            |         | X           |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
|                              |            |         |             |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
| XMSN Oil Pressure            | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X   | X   | X  |                                |
| XMSN Oil Pressure Low        | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X   | X   | X  |                                |
| XMSN Oil Temperature         | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X   | X   | X  |                                |
| XMSN Oil Temperature High    | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X   | X   | X  |                                |
| Chip Main XMSN               | NA         |         |             |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
| Chip Int XMSN                | NA         |         |             |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
| Chip Tail XMSN               | NA         |         |             |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |
| XMSN Oil Bypass              |            |         | X           |               |        |       |      |          |             |     |     |     |     |   |   |  |                                |

TABLE 22. CONTINUED.

| PARAMETER                         | PRIORITIES |         |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  |           | FORMAT        |             |              | RE-<br>PONSE |          | FEED-<br>BACK |          |               |                   |         |             |
|-----------------------------------|------------|---------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|--------------|----------|---------------|----------|---------------|-------------------|---------|-------------|
|                                   | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | ATWGT       | DAY | YMC | INC | HOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE  | COMBINED | CAUTION       | ADVISORY | AUTO DESTABLE | AUTO NOT DESTABLE | DISPLAY | UNNECESSARY |
| $H_R$                             |            |         | X           |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| Main Rotor Overspeed              | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X         |               |             | X            | X            |          |               |          | X             |                   |         |             |
| Low Rotor RPM                     | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X         |               |             | X            | X            |          |               |          | X             |                   |         |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| S Torque                          | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X         |               |             | X            | X            |          |               |          | X             |                   |         |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| Primary Servo Pressure Low        | NA         |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| Hydraulic Pump Pressure Low       | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X         |               |             | X            | X            |          |               |          | X             |                   |         |             |
| Primary Servo Jam                 | NA         |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| Boost Servo Jam                   | NA         |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| Boost Servo Pressure Low          | NA         |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| Tail Rotor Servo Pressure Low     | NA         |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| Backup Pump On                    | NA         |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
| Flight Control Hydraulic Pressure | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X         |               |             | X            | X            |          |               |          | X             |                   |         |             |
| Utility Hydraulic Pressure        | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X         |               |             | X            | X            |          |               |          | X             |                   |         |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |              |          |               |          |               |                   |         |             |

TABLE 22. CONTINUED.

| PARAMETER                    | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     |     | DISPLAY  | FORMAT    | RE-PONSE      |             | FEED-BACK    |             |          |         |          |                  |                      |         |             |
|------------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|----------|---------|----------|------------------|----------------------|---------|-------------|
|                              | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | RIGHT       | DAY | WVC | INC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTROYABLE | AUTO NOT DESTROYABLE | DISPLAY | UNNECESSARY |
| APU Exhaust Temperature High | X          |         |             | X             |        | X     |      | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| APU Oil Pressure Low         | X          |         |             | X             |        | X     |      | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| APU Overspeed                | X          |         |             | X             |        | X     |      | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| APU Underspeed               | X          |         |             | X             |        | X     |      | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| APU Sequence Fail            | X          |         |             | X             |        | X     |      | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| APU Fire                     | X          |         |             | X             |        | X     |      | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| APU Generator On             |            |         | X           |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |
| APU On                       |            | X       |             | X             |        | X     |      | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| APU Tachometer               |            |         | X           |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |
|                              |            |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |
|                              |            |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |
| Generator Output             | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| AC Inverter Output Low       | NA         |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |
| Converter Output Low         | NA         |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |
| Rectifier Off                | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| Battery Low Charge           |            | X       |             | X             | X      | X     | X    | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| Battery Fault                | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   |          | X         |               |             |              |             | X        |         | X        |                  |                      |         |             |
| AC ESS Bus Off               | NA         |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |
| DC Ess Bus Off               | NA         |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |
| External Power Connected     |            |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |          |         |          |                  |                      |         |             |

TABLE 22. CONTINUED.

| PARAMETER                  | PRIORITIES                                      | MISSION PHASE                                   | ENVIRONMENT                                    | DISPLAY                                   | FORMAT  | RE-<br>PONSE                             | FEED-<br>BACK                  |
|----------------------------|---|---|--|---|---|--|--------------------------------|
|                            | SAFETY<br>MISSION<br>MAINTENANCE<br>UNNECESSARY | TAKEOFF<br>CRUISE<br>HOVER<br>LAND<br>SHOOTDOWN | BRIGHT<br>DAY<br>VNC<br>TMC<br>HDE<br>ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>AUTOMATIC | AUTO DESTABILIZE<br>AUTO NOT DESTABILIZE | DISPLAY<br>DISPLAY UNNECESSARY |
| AC Load Meter              | X   |   |  |   |   |  |                                |
| DC Load Meter              | X   |   |  |   |   |  |                                |
| Engine Fire                | X   | X X X X X                                       | X X X X X X                                    | X   | X   | X  |                                |
| Flt Path Stab Sys Fail     | NA  |   |  |   |   |  |                                |
| Stabilator Auto Mode In Op | NA  |   |  |   |   |  |                                |
| Stabilator Position        | NA  |   |  |   |   |  |                                |
| SAS Off                    | X   | X X X X X                                       | X X X X X X                                    | X   | X   | X  |                                |
| Pitch Bias Failure         | NA  |   |  |   |   |  |                                |
| Gust lock Not Disengaged   | NA  |   |  |   |   |  |                                |
| ISF In this after          | X   | X X X X X                                       | X X X X X X                                    | X   | X   | X  |                                |

TABLE 22. CONTINUED.

| PARAMETER             | PRIORITIES |         |                            | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |      | DISPLAY |          | FORMAT    |               |             | RE-<br>PONSE | FEED-<br>BACK |          |         |          |                |                    |         |             |
|-----------------------|------------|---------|----------------------------|---------------|--------|-------|------|-------------|-----|-----|------|---------|----------|-----------|---------------|-------------|--------------|---------------|----------|---------|----------|----------------|--------------------|---------|-------------|
|                       | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | WIND        | DAY | WVC | ZINC | NOE     | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE   | COMBINED | CAUTION | ADVISORY | AUTO DESIRABLE | AUTO NOT DESIRABLE | DISPLAY | UNNECESSARY |
| Eng. Anti-Ice On      | X          |         |                            | X             | X      | X     | X    | X           | X   | X   | X    | X       | X        | X         |               |             |              |               |          |         |          | X              |                    | X       |             |
|                       |            |         |                            |               |        |       |      |             |     |     |      |         |          |           |               |             |              |               |          |         |          |                |                    |         |             |
| Pitot Heat On         | X          |         |                            | X             | X      | X     | X    | X           | X   | X   | X    | X       | X        | X         |               |             |              |               |          |         | X        | X              |                    | X       |             |
|                       |            |         |                            |               |        |       |      |             |     |     |      |         |          |           |               |             |              |               |          |         |          |                |                    |         |             |
| Heater On             |            | X       |                            | X             | X      | X     | X    | X           | X   | X   | X    | X       | X        |           | X             |             |              |               |          |         | X        | X              |                    | X       |             |
| Heater Int            |            | X       |                            | X             | X      | X     | X    | X           | X   | X   | X    | X       | X        |           | X             |             |              |               |          | X       | X        |                | X                  |         |             |
|                       |            |         |                            |               |        |       |      |             |     |     |      |         |          |           |               |             |              |               |          |         |          |                |                    |         |             |
| Cargo Hook Open       | X          |         |                            | X             | X      | X     | X    | X           | X   | X   | X    | X       | X        | X         |               |             |              |               |          |         | X        |                | X                  |         |             |
| Cargo Hook Armed      | X          |         |                            | X             | X      | X     | X    | X           | X   | X   | X    | X       | X        |           | X             |             |              |               |          |         | X        |                | X                  |         |             |
|                       |            |         |                            |               |        |       |      |             |     |     |      |         |          |           |               |             |              |               |          |         |          |                |                    |         |             |
| Parking Brake On      | X          |         |                            | X             | X      | X     | X    | X           | X   | X   | X    | X       | X        | X         |               |             |              |               |          |         | X        |                | X                  |         |             |
|                       |            |         |                            |               |        |       |      |             |     |     |      |         |          |           |               |             |              |               |          |         |          |                |                    |         |             |
| Eng. Start Valve Open |            |         | X                          |               |        |       |      |             |     |     |      |         |          |           |               |             |              |               |          |         |          |                |                    |         |             |
|                       |            |         |                            |               |        |       |      |             |     |     |      |         |          |           |               |             |              |               |          |         |          |                |                    |         |             |

TABLE 22. CONTINUED.

Additional Areas

Please answer the following questions:

Can you think of any other items of subsystem information that should be displayed in future helicopters?

V<sub>NE</sub>: Approaching or exceed

Speed trim not extending/retracting with change in airspeed

Fuel flow meters

Digital readout for weight on hook

Which caution/warning lights have you found illuminate most frequently?  
How frequently? During what conditions?

Chip detector (engine)

Wheel dephased

Are there any caution/warning lights that you have found to be unreliable?

Engine chip

XMSN chip

Fire handle

TABLE 22. CONTINUED.

What aspects of subsystem monitoring have you found to be most problematic, annoying, or distracting during NOE flight?  
Monitoring engine indications not backed up by caution lights

How do you feel about presenting information through voice warning systems or through beeps, tones, etc.?

Excellent, so long as they don't interfere with communications, and so long as beeps/tones are not confused with other aircraft sounds.

Problematic where sensors are unreliable.

Should allow for re-set turnoff.

What problems do you see arising with systems that require you to push buttons to obtain information about subsystems?

Recommend cyclic/thrust locations.

TABLE 23. OH-58C PILOT CONSENSUS.

| PARAMETER                   | PRIORITIES |         |                            | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  | FORMAT                                    | RE-<br>PONSE   |                                      | FEED-<br>BACK          |
|-----------------------------|------------|---------|----------------------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|---|--|--------------------------------------|------------------------|
|                             | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | INC | ROE | ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESIRABLE<br>AUTO NOT DESIRABLE | DISPLAY<br>UNNECESSARY |
| Fuel Quantity               | X          |         |                            | X             | X      |       |      |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
| Fuel low                    | X          |         |                            | X             | X      | X     |      |          | X           | X   | X   | X   | X   |          | X   | X  |                                      | X                      |
| Fuel Pressure               |            | X       |                            | X             |        |       | X    |          | X           | X   |     |     |     |          | X   | X  | X                                    | X                      |
| Fuel Pressure Low           | X          |         |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
| Fuel Filter Obstructed      |            | X       |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
| Prime Boost Pump On         | X          |         |                            | X             |        |       |      |          | X           | X   | X   | X   |     |          | X   | X  |                                      | X                      |
| Fuel Boost Pressure low     | X          |         |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
|                             |            |         |                            |               |        |       |      |          |             |     |     |     |     |          |   |  |                                      |                        |
| Engine Oil Temperature      |            | X       |                            |               |        |       |      |          |             |     |     |     |     |          | X   | X  | X                                    | X                      |
| Engine Oil Temperature High | X          |         |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
| Engine Oil Pressure         |            | X       |                            |               |        |       |      |          |             |     |     |     |     |          | X   | X  | X                                    | X                      |
| Engine Oil Pressure low     | X          |         |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
| Engine Oil Quantity         |            | X       |                            |               |        |       |      |          |             |     |     |     |     |          | X   | X  | X                                    | X                      |
| Engine Oil Quantity low     | X          |         |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
| Oil Filter Bypass           |            | X       |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
| Engine Chip                 | X          |         |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X   |          | X   | X  | X                                    | X                      |
|                             |            |         |                            |               |        |       |      |          |             |     |     |     |     |          |   |  |                                      |                        |
|                             |            |         |                            |               |        |       |      |          |             |     |     |     |     |          |   |  |                                      |                        |

TABLE 23. CONTINUED.

| PARAMETER                             | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY | FORMAT   | RE-<br>PONSE | FEED-<br>BACK |             |              |             |          |         |          |               |                   |         |             |
|---------------------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|----------|--------------|---------------|-------------|--------------|-------------|----------|---------|----------|---------------|-------------------|---------|-------------|
|                                       | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | VMC | IMC | MODE    | ALTITUDE | CONTINUAL    | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTABLE | AUTO NOT DESTABLE | DISPLAY | UNNECESSARY |
| TIT                                   | X          |         |             | X             | X      |       |      | X           | X   | X   | X   |         |          | X            |               |             |              |             | X        |         |          | X             |                   | X       |             |
| EGT                                   |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| N <sub>p</sub>                        |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| Inlet Air Pressure Negative           |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
|                                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| N <sub>g</sub>                        |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| Engine Out                            | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X            |               |             |              | X           |          |         |          | X             |                   | X       |             |
| N <sub>1</sub> Control Loop Energized |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
|                                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
|                                       |            |         |             |               |        |       |      |             |     |     |     |         |          |              |               |             |              |             |          |         |          |               |                   |         |             |
| XMSN Oil Pressure                     |            | X       |             |               |        |       |      |             |     |     |     |         |          | X            |               |             | X            | X           | X        | X       | X        | X             |                   | X       |             |
| XMSN Oil Pressure Low                 | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X            |               |             | X            | X           | X        | X       | X        | X             |                   | X       |             |
| XMSN Oil Temperature                  |            | X       |             |               |        |       |      |             |     |     |     |         |          | X            |               |             | X            | X           | X        | X       | X        | X             |                   | X       |             |
| XMSN Oil Temperature High             | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X            |               |             | X            | X           | X        | X       | X        | X             |                   | X       |             |
| Chip Main XMSN                        | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X            |               |             |              | X           |          |         |          | X             |                   | X       |             |
| Chip Int XMSN                         | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X            |               |             |              | X           |          |         |          | X             |                   | X       |             |
| Chip Tail XMSN                        | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X            |               |             |              | X           |          |         |          | X             |                   | X       |             |
| XMSN Oil Bypass                       | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X        | X            |               |             |              | X           |          |         |          | X             |                   | X       |             |

TABLE 23. CONTINUED.

| PARAMETER                         | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY   |               | FORMAT       |             | RE-<br>PONSE  |                   | FEED-<br>BACK |             |
|-----------------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|-----------|---------------|--------------|-------------|---------------|-------------------|---------------|-------------|
|                                   | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | INC | MOE | CONTINUAL | CRITICAL ONLY | QUANTITATIVE | QUALITATIVE | AUTO DESTABLE | AUTO NOT DESTABLE | DISPLAY       | UNNECESSARY |
| N <sub>R</sub>                    | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   |               |             |
| Main Rotor Overspeed              | X          | X       |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Low Rotor RPM                     | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
|                                   |            |         |             |               |        |       |      |             |     |     |     |           |               |              |             |               |                   |               |             |
| % Torque                          | X          |         |             | X             | X      | X     |      | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
|                                   |            |         |             |               |        |       |      |             |     |     |     |           |               |              |             |               |                   |               |             |
| Primary Servo Pressure Low        | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Hydraulic Pump Pressure Low       | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Primary Servo Jam                 | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Boost Servo Jam                   | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Boost Servo Pressure Low          | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Tail Rotor Servo Pressure Low     | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Backup Pump On                    | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Flight Control Hydraulic Pressure |            | X       |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
| Utility Hydraulic Pressure        |            | X       |             | X             | X      | X     | X    | X           | X   | X   | X   | X         |               | X            |             | X             |                   | X             |             |
|                                   |            |         |             |               |        |       |      |             |     |     |     |           |               |              |             |               |                   |               |             |
|                                   |            |         |             |               |        |       |      |             |     |     |     |           |               |              |             |               |                   |               |             |

TABLE 23. CONTINUED.

| PARAMETER                    | PRIORITIES |         |                            | MISSION PHASE |        |       |      | ENVIRONMENT |       |     |     | DISPLAY | FORMAT | RE-<br>PONSE | FEED-<br>BACK                             |  |  |                                |
|------------------------------|------------|---------|----------------------------|---------------|--------|-------|------|-------------|-------|-----|-----|---------|--------|--------------|---|--|--|--------------------------------|
|                              | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN    | NIGHT | DAY | WVC | INC     | NOE    | ALTITUDE     | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESTROYABLE<br>AUTO NOT DESTROYABLE | DISPLAY<br>DISPLAY UNNECESSARY |
| APU Exhaust Temperature High | X          |         |                            | X             |        |       | X    |             | X     | X   |     |         |        |              | X   |  | X  | X                              |
| APU Oil Pressure Low         | X          |         |                            | X             |        |       | X    |             | X     | X   |     |         |        |              | X   |  | X  | X                              |
| APU Overspeed                | X          |         |                            | X             |        |       | X    |             | X     | X   |     |         |        |              | X   |  | X  | X                              |
| APU Underspeed               | X          |         |                            | X             |        | X     | X    |             | X     | X   |     |         |        |              | X   |  | X  | X                              |
| APU Sequence Fail            | X          |         |                            | X             |        | X     | X    |             | X     | X   |     |         |        |              | X   |  | X  | X                              |
| APU Fire                     | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |
| APU Generator On             | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |
| APU On                       | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |
| APU Tachometer               |            |         | X                          |               |        |       |      |             |       |     |     |         |        |              |   |  |  |                                |
|                              |            |         |                            |               |        |       |      |             |       |     |     |         |        |              |   |  |  |                                |
|                              |            |         |                            |               |        |       |      |             |       |     |     |         |        |              |   |  |  |                                |
| Generator Output             |            |         | X                          |               |        |       |      |             |       |     |     |         |        |              |   |  |  |                                |
| AC Inverter Output low       | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |
| Converter Output low         | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |
| Rectifier Off                | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |
| Battery Low Charge           |            | X       |                            | X             |        |       | X    |             | X     | X   |     |         |        |              | X   |  | X  | X                              |
| Battery Fault                | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |
| AC ESS Bus Off               | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |
| DC Ess Bus Off               | X          |         |                            | X             | X      | X     | X    |             | X     | X   | X   | X       | X      |              | X   |  | X  | X                              |

TABLE 23. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             |             | MISSION PHASE |        |       |      | ENVIRONMENT |      |     |     | DISPLAY |     | FORMAT   |           | RE-<br>PONSE  |             | FEED-<br>BACK |             |          |         |          |               |                   |         |             |
|----------------------------|------------|---------|-------------|-------------|---------------|--------|-------|------|-------------|------|-----|-----|---------|-----|----------|-----------|---------------|-------------|---------------|-------------|----------|---------|----------|---------------|-------------------|---------|-------------|
|                            | SAFETY     | MISSION | MAINTENANCE | UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN    | WIND | DAY | WVC | IMC     | MOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE  | QUALITATIVE | COMBINED | CAUTION | ADVISORY | AUTO DESTABLE | AUTO NOT DESTABLE | DISPLAY | UNNECESSARY |
| AC Load Meter              |            |         | X           |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |
| DC Load Meter              |            |         | X           |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |
|                            |            |         |             |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |
| Engine Fire                | X          |         |             |             | X             | X      | X     | X    | X           | X    | X   | X   | X       | X   | X        | X         |               |             |               | X           |          | X       |          | X             |                   | X       |             |
| Flt Path Stab Sys Fail     | X          |         |             |             | X             | X      | X     |      |             | X    | X   | X   | X       | X   | X        | X         |               |             |               | X           |          | X       |          | X             |                   | X       |             |
| Stabilator Auto Mode In Op | X          |         |             |             | X             | X      | X     | X    | X           | X    | X   | X   | X       | X   | X        | X         |               |             |               | X           |          | X       |          | X             |                   | X       |             |
| Stabilator Position        | X          |         |             |             | X             |        | X     |      |             | X    | X   | X   | X       | X   | X        | X         |               |             |               | X           |          | X       |          | X             |                   | X       |             |
|                            |            |         |             |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |
| SAS Off                    | X          |         |             |             | X             | X      | X     | X    | X           | X    | X   | X   | X       | X   | X        | X         |               |             |               | X           |          | X       |          | X             |                   | X       |             |
|                            |            |         |             |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |
| Pitch Bias Failure         | X          |         |             |             | X             | X      |       |      |             | X    | X   | X   | X       | X   | X        | X         |               |             |               | X           |          | X       |          | X             |                   | X       |             |
|                            |            |         |             |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |
| Gust Lock Not Disengaged   |            |         | X           |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |
|                            |            |         |             |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |
| IFF In-Operative           |            |         | X           |             |               |        |       |      |             |      |     |     |         |     |          |           |               |             |               |             |          |         |          |               |                   |         |             |

TABLE 23. CONTINUED.

| PARAMETER        | PRIORITIES |         |                            | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     | DISPLAY | FORMAT   | RE-<br>PONSE                              |  | FEED-<br>BACK                          |                        |
|------------------|------------|---------|----------------------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|---------|----------|---|--|--|------------------------|
|                  | SAFETY     | MISSION | MAINTENANCE<br>UNNECESSARY | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | WIND        | DAY | WPC | JPC | WDE     | ALTITUDE | CONTINUAL<br>CRITICAL ONLY<br>ACCESS ONLY | QUANTITATIVE<br>QUALITATIVE<br>COMBINED<br>CAUTION<br>ADVISORY | AUTO DESTINABLE<br>AUTO NOT DESTINABLE | DISPLAY<br>UNNECESSARY |
| Eng. Anti-Ice On | X          |         |                            | X             | X      |       | X    | X        | X           | X   |     |     | X       |          | X   |  | X                                      | X                      |
| Pilot Heat On    | X          |         |                            | X             | X      | X     | X    | X        | X           | X   |     |     | X       |          | X   |  | X                                      | X                      |
| Heater On        |            |         | X                          |               |        |       |      |          |             |     |     |     |         |          |   |  |  |                        |
| Heater Hot       | X          |         |                            | X             | X      | X     | X    | X        | X           | X   | X   | X   | X       |          | X   |  | X                                      | X                      |
| Cargo Hook Open  | X          |         |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X       |          | X   |  | X                                      | X                      |
| Cargo Hook Armed | X          |         |                            | X             | X      | X     | X    |          | X           | X   | X   | X   | X       |          | X   |  | X                                      | X                      |

TABLE 23. CONTINUED.

Additional Areas

Please answer the following questions:

Can you think of any other items of subsystem information that should be displayed in future helicopters?

1. A system to inform the pilot where hits were scored on his A/C while in a combat environment. Damage report if you will.
2. Some type of load measure to inform the pilot of the weight he is about to pick up.
3. An indication of the presence of ice on the blades.
4. An indication of a door that is not secure.
5. A sequence light for starting procedure and shutdown procedure, if proper sequence is not followed light comes on.
6. Display of the proper emergency procedure to accompany the caution light or audio instructions to each the pilot and copilot as to their proper actions.
7. Fuel management system

Which caution/warning lights have you found illuminate most frequently?  
How frequently? During what conditions?

|             |                                  |                        |
|-------------|----------------------------------|------------------------|
| Eng. Fire - | The frequency depends on the A/C | - Usually during runup |
| Chip Lgt. - | "                                | - Varied               |
| Rec. Lgt. - | "                                | - Usually during runup |

Are there any caution/warning lights that you have found to be unreliable?

Unfortunately, the chip lights usually are unreliable.

TABLE 23. CONTINUED.

What aspects of subsystem monitoring have you found to be most problematic, annoying, or distracting during NOE flight?

I am not qualified to respond as to NOE however using similar techniques in civilian work I found gauges in general to be annoying and difficult to read.

How do you feel about presenting information through voice warning systems or through beeps, tones, etc.?

GREAT---provided! audio systems should present the information in much the same manner as a copilot would. ie, a tone to inform you a message is coming then a brief, concise description of the problem.

What problems do you see arising with systems that require you to push buttons to obtain information about subsystems?

Without a copilot to assist you alot! With a copilot very little if any examples: control while hand and eye are pushing buttons, errors in pushing the right buttons.

TABLE 24. AH-1G PILOT CONSENSUS.

| PARAMETER                   | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     |     | DISPLAY  |           | FORMAT        |             | RE-<br>PONSE |             | FEED-<br>BACK |         |          |                 |                     |         |             |
|-----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|---------------|---------|----------|-----------------|---------------------|---------|-------------|
|                             | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | HEIGHT      | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED      | CAUTION | ADVISORY | AUTO DESTINABLE | AUTO NOT DESTINABLE | DISPLAY | UNNECESSARY |
| Fuel Quantity               | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             | X            |             |               |         |          | X               |                     |         |             |
| Fuel Low                    | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             | X            |             | X             |         |          | X               |                     |         |             |
| Fuel Pressure               | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             | X            |             | X             |         |          | X               |                     |         |             |
| Fuel Pressure Low           | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             |              | X           |               |         |          | X               |                     |         |             |
| Fuel Filter Obstructed      | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             |              | X           |               |         |          | X               |                     | X       |             |
| Prime Boost Pump On         |            |         | X           |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                 |                     |         |             |
| Fuel Boost Pressure Low     |            |         | X           |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                 |                     |         |             |
|                             |            |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                 |                     |         |             |
| Engine Oil Temperature      | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             | X            |             | X             |         |          | X               |                     |         |             |
| Engine Oil Temperature High | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             |              | X           |               |         |          | X               |                     |         |             |
| Engine Oil Pressure         | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             | X            |             | X             |         |          | X               |                     |         |             |
| Engine Oil Pressure low     | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             |              | X           |               |         |          | X               |                     |         |             |
| Engine Oil Quantity         |            |         | X           |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                 |                     |         |             |
| Engine Oil Quantity low     | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             |              | X           |               |         |          | X               |                     |         |             |
| Oil Filter Bypass           | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             |              | X           |               |         |          | X               |                     | X       |             |
| Engine Chip                 | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X   | X        | X         |               |             |              | X           |               |         |          | X               |                     |         |             |
|                             |            |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                 |                     |         |             |
|                             |            |         |             |               |        |       |      |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                 |                     |         |             |

TABLE 24. CONTINUED.

| PARAMETER                    | PRIORITIES |         |             | MISSION PHASE |        |       | ENVIRONMENT |     |     |     |     |          | DISPLAY                                 | FORMAT       |             |                     | RE-<br>PONSE                         | FEED-<br>BACK          |
|------------------------------|------------|---------|-------------|---------------|--------|-------|-------------|-----|-----|-----|-----|----------|---|--------------|-------------|---------------------|--------------------------------------|------------------------|
|                              | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | RIGHT       | DAY | WVC | INC | NOE | ALTITUDE |   | QUANTITATIVE | QUALITATIVE | COMBINED            |                                      |                        |
|                              |            |         | UNNECESSARY |               |        | LAND  |             |     |     |     |     |          | CENTRAL<br>CRITICAL ONLY<br>ACCESS ONLY |              |             | CAUTION<br>ADVISORY | AUTO DESIRABLE<br>AUTO NOT DESIRABLE | DISPLAY<br>UNNECESSARY |
| VIT                          |            |         | X           |               |        |       |             |     |     |     |     |          |   |              |             |                     |                                      |                        |
| EGT                          | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              |             |                     | X                                    |                        |
| $N_p$                        |            |         | X           |               |        |       |             |     |     |     |     |          |   |              |             |                     |                                      |                        |
| Inlet Air Pressure Negative  |            |         | X           |               |        |       |             |     |     |     |     |          |   |              |             |                     |                                      |                        |
|                              |            |         |             |               |        |       |             |     |     |     |     |          |   |              |             |                     |                                      |                        |
| $N_g$                        |            |         | X           |               |        |       |             |     |     |     |     |          |   |              |             |                     |                                      |                        |
| Engine Out                   | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              |             |                     | X                                    |                        |
| $N_1$ Control Loop Energized |            |         | X           |               |        |       |             |     |     |     |     |          |   |              |             |                     |                                      |                        |
|                              |            |         |             |               |        |       |             |     |     |     |     |          |   |              |             |                     |                                      |                        |
| XMSN Oil Pressure            | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              | X           |                     | X                                    |                        |
| XMSN Oil Pressure Low        | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              | X           |                     | X                                    |                        |
| XMSN Oil Temperature         | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              | X           |                     | X                                    |                        |
| XMSN Oil Temperature High    | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              | X           |                     | X                                    |                        |
| Chip Main XMSN               | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              | X           |                     | X                                    |                        |
| Chip Int XMSN                | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              | X           |                     | X                                    |                        |
| Chip Tail XMSN               | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              | X           |                     | X                                    |                        |
| XMSN Oil Bypass              | X          |         |             | X             | X      | X     | X           | X   | X   | X   | X   |          | X                                       |              | X           |                     | X                                    | X                      |

TABLE 24. CONTINUED.

| PARAMETER                         | PRIORITIES |         |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  |           | FORMAT        |             | RE-<br>PONSE |             | FEED-<br>BACK |         |          |                  |                      |         |             |
|-----------------------------------|------------|---------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|-----------|---------------|-------------|--------------|-------------|---------------|---------|----------|------------------|----------------------|---------|-------------|
|                                   | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | NOE | ALTITUDE | CONTINUAL | CRITICAL ONLY | ACCESS ONLY | QUANTITATIVE | QUALITATIVE | COMBINED      | CAUTION | ADVISORY | AUTO DESTROYABLE | AUTO NOT DESTROYABLE | DISPLAY | UNNECESSARY |
| N <sub>R</sub>                    | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X         |               |             | X            |             |               |         |          | X                |                      |         |             |
| Main Rotor Overspeed              | X          |         |             | X             | X      | X     | X    |          | X           | X   | X   | X   | X   | X        |           | X             |             |              | X           |               |         |          | X                |                      | X       |             |
| Low Rotor RPM                     | X          |         |             | X             | X      | X     | X    |          | X           | X   | X   | X   | X   | X        |           | X             |             |              | X           |               |         |          | X                |                      | X       |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
| % Torque                          | X          |         |             | X             | X      | X     | X    |          | X           | X   | X   | X   | X   | X        |           | X             |             |              | X           |               |         |          | X                |                      |         |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
| Primary Servo Pressure Low        |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
| Hydraulic Pump Pressure Low       | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        |           | X             |             |              | X           |               |         |          | X                |                      |         |             |
| Primary Servo Jam                 |            | X       |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
| Boost Servo Jam                   |            | X       |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
| Boost Servo Pressure Low          |            | X       |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
| Tail Rotor Servo Pressure Low     |            | X       |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
| Backup Pump On                    |            | X       |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
| Flight Control Hydraulic Pressure | X          |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        |           | X             |             |              | X           |               |         |          | X                |                      |         |             |
| Utility Hydraulic Pressure        |            | X       |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |
|                                   |            |         |             |               |        |       |      |          |             |     |     |     |     |          |           |               |             |              |             |               |         |          |                  |                      |         |             |

TABLE 24. CONTINUED.

| PARAMETER                    | PRIORITIES | MISSION PHASE |         |         |        |          | ENVIRONMENT |     |     |     |     | DISPLAY       | FORMAT               | RE-<br>PONSE | FEED-<br>BACK |
|------------------------------|------------|---------------|---------|---------|--------|----------|-------------|-----|-----|-----|-----|---------------|----------------------|--------------|---------------|
|                              |            | SAFETY        | MISSION | TAKEOFF | CRUISE | LAND     | WIGHT       | DAY | WPC | IMC | NOE |               |                      |              |               |
|                              |            | UNNECESSARY   |         | COVER   |        | SHUTDOWN |             |     |     |     |     | CRITICAL ONLY | QUANTITATIVE         |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     | ACCESS ONLY   | QUALITATIVE          |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               | COMBINED             |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               | CAUTION              |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               | ADVISORY             |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               | AUTO DESTROYABLE     |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               | AUTO NOT DESTROYABLE |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU Exhaust Temperature High | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU Oil Pressure Low         | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU Overspeed                | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU Underspeed               | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU Sequence Fail            | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU Fire                     | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU Generator On             | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU On                       | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| APU Tachometer               | NA         |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
|                              |            |               |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| Generator Output             | X          |               | X       | X       | X      | X        | X           | X   | X   | X   | X   | X             | X                    | X            | X             |
| AC Inverter Output low       | X          |               | X       | X       | X      | X        | X           | X   | X   | X   | X   | X             | X                    | X            | X             |
| Converter Output Low         |            | X             |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| Rectifier Off                |            | X             |         |         |        |          |             |     |     |     |     |               |                      |              |               |
| Battery Low Charge           | X          |               | X       | X       | X      | X        | X           | X   | X   | X   | X   | X             | X                    | X            | X             |
| Battery Fault                | X          |               | X       | X       | X      | X        | X           | X   | X   | X   | X   | X             | X                    | X            | X             |
| AC ESS Bus Off               | X          |               | X       | X       | X      | X        | X           | X   | X   | X   | X   | X             | X                    | X            | X             |
| DC Ess Bus Off               | X          |               | X       | X       | X      | X        | X           | X   | X   | X   | X   | X             | X                    | X            | X             |

TABLE 24. CONTINUED.

| PARAMETER                  | PRIORITIES |         |             | MISSION PHASE |        |       |      | ENVIRONMENT |     |     |     | DISPLAY | FORMAT       |             |          | RE-<br>PONSE | FEED-<br>BACK |
|----------------------------|------------|---------|-------------|---------------|--------|-------|------|-------------|-----|-----|-----|---------|--------------|-------------|----------|--------------|---------------|
|                            | SAFETY     | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | NIGHT       | DAY | VMC | IMC | MOE     | QUANTITATIVE | QUALITATIVE | COMBINED |              |               |
| AC Load Meter              |            | X       |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X            |             | X        | X            |               |
| DC Load Meter              |            | X       |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X            |             | X        | X            |               |
| Engine Fire                | X          |         |             | X             | X      | X     | X    | X           | X   | X   | X   | X       | X            |             | X        | X            |               |
| Flt Path Stab Sys Fail     | NA         |         |             |               |        |       |      |             |     |     |     |         |              |             |          |              |               |
| Stabilator Auto Mode In Op | NA         |         |             |               |        |       |      |             |     |     |     |         |              |             |          |              |               |
| Stabilator Position        |            | X       |             |               |        |       |      |             |     |     |     |         |              |             |          |              |               |
| SAS Off                    |            | X       |             |               |        |       |      |             |     |     |     |         |              |             |          |              |               |
| Pitch Bias Failure         | NA         |         |             |               |        |       |      |             |     |     |     |         |              |             |          |              |               |
| Gust Lock Not Disengaged   | NA         |         |             |               |        |       |      |             |     |     |     |         |              |             |          |              |               |
| III In Operative           | NA         |         |             |               |        |       |      |             |     |     |     |         |              |             |          |              |               |

TABLE 24. CONTINUED.

| PARAMETER             | PRIORITIES  |         |             | MISSION PHASE |        |       |      |          | ENVIRONMENT |     |     |     |     | DISPLAY  | FORMAT        | RE-<br>PONSE |                    | FEED-<br>BACK |
|-----------------------|-------------|---------|-------------|---------------|--------|-------|------|----------|-------------|-----|-----|-----|-----|----------|---------------|--------------|--------------------|---------------|
|                       | SAFETY      | MISSION | MAINTENANCE | TAKEOFF       | CRUISE | HOVER | LAND | SHUTDOWN | NIGHT       | DAY | VMC | IMC | HOE | ALTITUDE | CONTINUAL     | QUANTITATIVE | AUTO               | FEEDBACK      |
|                       | UNNECESSARY |         |             |               |        |       |      |          |             |     |     |     |     |          | CRITICAL ONLY | QUALITATIVE  | DESIRABLE          | UNNECESSARY   |
|                       |             |         |             |               |        |       |      |          |             |     |     |     |     |          | ACCESS ONLY   | COMBINED     | AUTO NOT DESIRABLE | DISPLAY       |
|                       |             |         |             |               |        |       |      |          |             |     |     |     |     |          |               | CAUTION      |                    |               |
|                       |             |         |             |               |        |       |      |          |             |     |     |     |     |          |               | ADVISORY     |                    |               |
|                       |             |         |             |               |        |       |      |          |             |     |     |     |     |          |               |              |                    |               |
| Eng. Anti-ice On      | X           |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X             | X            | X                  |               |
| Pilot Heat On         | X           |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X             | X            | X                  |               |
| Heater On             |             |         | X           |               |        |       |      |          |             |     |     |     |     |          |               |              |                    |               |
| Heater Hot            |             |         | X           |               |        |       |      |          |             |     |     |     |     |          |               |              |                    |               |
| Cargo Hook Open       | X           |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X             | X            | X                  |               |
| Cargo Hook Armed      | X           |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X             | X            | X                  |               |
| Parking Brake On      |             |         | X           |               |        |       |      |          |             |     |     |     |     |          |               |              |                    |               |
| Eng. Start Valve Open |             |         | X           |               |        |       |      |          |             |     |     |     |     |          |               |              |                    |               |
| Master Caution        | X           |         |             | X             | X      | X     | X    | X        | X           | X   | X   | X   | X   | X        | X             | X            | X                  |               |

TABLE 24. CONTINUED.

Additional Areas

Please answer the following questions:

Can you think of any other items of subsystem information that should be displayed in future helicopters?

A/S below effective translational lift.  
Mast movement indicator on rigid rotors.

Which caution/warning lights have you found illuminate most frequently?  
How frequently? During what conditions?

Aux. Fuel Low  
RPM High  
Engine Chip  
Fire Warning Light (UH-1H)  
Fuel Boost Pumps During Cruise  
Tail Rotor Chip  
DC Gen. - at low RPM after autorotation  
Hydraulics Off

Are there any caution/warning lights that you have found to be unreliable?

At times hydraulic pressure warning will not illuminate for several seconds after system is inoperative. (UH-1)

20 min. fuel light  
Fire Warning (UH-1H)  
Hydraulics Off

UNITED TECHNOLOGIES CORP STRATFORD CT SIKORSKY AIRCR--ETC F/6 1/3

ADVANCED SUBSYSTEMS STATUS MONITOR. (U)

APR 80 J MCGEE, H HARPER DAAK51-78-C-0023

DAAK51-78-C-0023

SER-510025

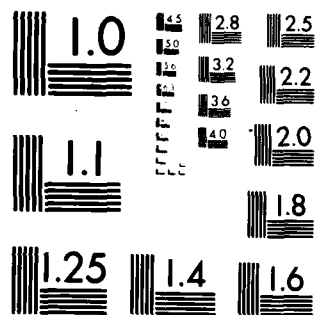
USAAVRADCOM-TR-80-D-5 NL

NL

 $\frac{1}{2} \times 10^{-12}$ 

100

END  
DATE  
FILMED  
7 80  
DTIC



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963 A

TABLE 24. CONTINUED.

What aspects of subsystem monitoring have you found to be most problematic, annoying, or distracting during NOE flight?

Eng./XMSN instruments in new A/C.

#, %, tic marks difficult and time consuming to interpret.

Electrical system monitoring

How do you feel about presenting information through voice warning systems or through beeps, tones, etc.?

Excellent, especially as backup.

Recommend visual backup.

Washout problem possible.

Recommend incorporation of procedural info.

Recommend preceding tone to message.

What problems do you see arising with systems that require you to push buttons to obtain information about subsystems?

Possible confusion

System failure?

Reaction - actuation delay

TABLE 25. HELICOPTER X MISSION PHASE MATRIX.

| SUBSYSTEM          | PARAMETER                   | UH-60A   |          |        |       |      | CH-47C   |          |          |        |       | OH-58C |          |          |          |        | MH-1G |      |          |          |          |        |       |      |          |          |   |
|--------------------|-----------------------------|----------|----------|--------|-------|------|----------|----------|----------|--------|-------|--------|----------|----------|----------|--------|-------|------|----------|----------|----------|--------|-------|------|----------|----------|---|
|                    |                             | PRE/POST | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST | SHUTDOWN | TAKE-OFF | CRUISE | HOVER | LAND   | PRE/POST | SHUTDOWN | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST | SHUTDOWN | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST | SHUTDOWN |   |
| Engine Fuel        | Fuel Quantity               | I        | -        | I      | -     | I    | -        | I        | -        | I      | -     | I      | -        | I        | -        | I      | -     | I    | -        | I        | -        | I      | -     | I    | -        | I        | - |
|                    | Fuel Low                    | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C      | C        | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C    | C        | C        |   |
|                    | Fuel Pressure               |          |          |        |       |      |          |          |          |        |       |        |          |          |          |        |       |      |          |          |          |        |       |      |          |          |   |
|                    | Fuel Pressure Low           | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C      | C        | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C    | C        | C        |   |
|                    | Fuel Filter Obstruct/Bypass | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C      | C        | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C    | C        | C        |   |
| Engine Lubrication | Prime Boost Pump On         | A        | -        | -      | -     | -    | -        | -        | -        | -      | -     | -      | -        | -        | -        | -      | -     | -    | -        | -        | -        | -      | -     | -    | -        | -        |   |
|                    | Fuel Boost Press Low        |          |          |        |       |      |          |          |          |        |       |        |          |          |          |        |       |      |          |          |          |        |       |      |          |          |   |
|                    | Eng. Oil Temperature        | I        | -        | I      | -     | I    | -        | I        | -        | I      | -     | I      | -        | I        | -        | I      | -     | I    | -        | I        | -        | I      | -     | I    | -        | I        |   |
|                    | Eng. Oil Temp. High         | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C      | C        | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C    | C        | C        |   |
|                    | Eng. Oil Pressure           | I        | -        | I      | -     | I    | -        | I        | -        | I      | -     | I      | -        | I        | -        | I      | -     | I    | -        | I        | -        | I      | -     | I    | -        | I        |   |
| Engine Chip        | Eng. Oil Pressure Low       | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C      | C        | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C    | C        | C        |   |
|                    | Eng. Oil Quantity Low       |          |          |        |       |      |          |          |          |        |       |        |          |          |          |        |       |      |          |          |          |        |       |      |          |          |   |
|                    | Oil Filter Bypass           | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C      | C        | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C    | C        | C        |   |
|                    | Engine Chip                 | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C      | C        | C        | C        | C      | C     | C    | C        | C        | C        | C      | C     | C    | C        | C        |   |

I: analog instruments; W: warning light; C: caution light; A: advisory light;  
T: audio tone ; M: master caution light.

TABLE 25. CONTINUED.

| SUBSYSTEM       | PARAMETER                | UH-60A            |          |        |       |      |                      | CH-47C            |          |        |       |      |                      | OH-58C            |          |        |       |      |                      | AH-1G             |          |        |       |      |                      |   |   |   |   |   |   |   |   |   |   |   |   |  |
|-----------------|--------------------------|-------------------|----------|--------|-------|------|----------------------|-------------------|----------|--------|-------|------|----------------------|-------------------|----------|--------|-------|------|----------------------|-------------------|----------|--------|-------|------|----------------------|---|---|---|---|---|---|---|---|---|---|---|---|--|
|                 |                          | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN |   |   |   |   |   |   |   |   |   |   |   |   |  |
| Power Turbine   | Turbine Inlet Temp.      | I                 | I        | I      | I     | I    | I                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |   |   |   |   |   |   |   |   |   |   |   |   |  |
|                 | Np                       | I                 | I        | I      | I     | I    | I                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |   |   |   |   |   |   |   |   |   |   |   |   |  |
|                 | EGT (TOT)                |                   |          |        |       |      |                      | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I    | I                    | I | I | I | I | I | I | I | I | I | I | I |   |  |
|                 | Inlet Air Press. Neg.    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |   |   |   |   |   |   |   |   |   |   |   |   |  |
| Gas Generator   | Ng                       | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I    | I                    | I | I | I | I | I | I | I | I | I | I | I |   |  |
|                 | Engine Out               | -                 | M        | M      | M     | M    | -                    | -                 | -        | -      | -     | -    | -                    | -                 | -        | -      | -     | -    | -                    | -                 | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - | - | - | - | - |   |  |
|                 | M Control Loop Energized |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |   |   |   |   |   |   |   |   |   |   |   |   |  |
| JMSN            | JMSN Oil Pressure        | I                 | -        | I      | I     | -    | -                    | I                 | -        | I      | I     | -    | -                    | I                 | -        | I      | -     | I    | -                    | -                 | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - | - | - | - | - | - |  |
|                 | JMSN Oil Pressure Low    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C | C | C | C | C | C | C | C | C | C |   |   |  |
|                 | JMSN Oil Temperature     | I                 | -        | I      | I     | -    | -                    | I                 | -        | I      | I     | -    | -                    | I                 | -        | I      | -     | I    | -                    | -                 | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - | - | - | - | - |   |  |
|                 | JMSN Oil Temp. High      | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C | C | C | C | C | C | C | C | C | C |   |   |  |
|                 | Chip Main JMSN           | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C | C | C | C | C | C | C | C | C | C |   |   |  |
|                 | Chip Int JMSN            | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C | C | C | C | C | C | C | C | C | C |   |   |  |
|                 | Chip Tail JMSN           | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C    | C                    | C | C | C | C | C | C | C | C | C | C |   |   |  |
| JMSN Oil Bypass |                          |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |   |   |   |   |   |   |   |   |   |   |   |   |  |

TABLE 25. CONTINUED.

| SUBSYSTEM   | PARAMETER                  | UH-60A            |          |        |       |      | CH-47C               |                   |          |        |       | CH-53C |                      |                   |          |        | NH-1G |      |                      |  |  |
|-------------|----------------------------|-------------------|----------|--------|-------|------|----------------------|-------------------|----------|--------|-------|--------|----------------------|-------------------|----------|--------|-------|------|----------------------|--|--|
|             |                            | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND   | PRE/POST<br>SHUTDOWN | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN |  |  |
| Main Rotor  | Mr                         | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I      | I                    | I                 | I        | I      | I     | I    | I                    |  |  |
|             | Overspeed                  | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I      | I                    | I                 | I        | I      | I     | I    | I                    |  |  |
|             | Low Rotor RPM              | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I      | I                    | I                 | I        | I      | I     | I    | I                    |  |  |
| XRSM/Engine | % Torque                   | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I      | I                    | I                 | I        | I      | I     | I    | I                    |  |  |
|             | Primary Servo Press Low    | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C      | C                    | C                 | C        | C      | C     | C    | C                    |  |  |
|             | Hydraulic Pump Press Low   | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C      | C                    | C                 | C        | C      | C     | C    | C                    |  |  |
| Hydraulic   | Primary Servo Jam          | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C      | C                    | C                 | C        | C      | C     | C    | C                    |  |  |
|             | Boost Servo Jam            | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C      | C                    | C                 | C        | C      | C     | C    | C                    |  |  |
|             | Boost Servo Press Low      | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C      | C                    | C                 | C        | C      | C     | C    | C                    |  |  |
|             | Tail Rotor Servo Press Low | C                 | C        | C      | C     | C    | C                    | C                 | C        | C      | C     | C      | C                    | C                 | C        | C      | C     | C    | C                    |  |  |
|             | Backup Pump On             | A                 | A        | A      | A     | A    | A                    | A                 | A        | A      | A     | A      | A                    | A                 | A        | A      | A     | A    | A                    |  |  |
|             | Flt. Ctrl. Hyd. Press      | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I      | I                    | I                 | I        | I      | I     | I    | I                    |  |  |
|             | Utility Hyd. Press         | I                 | I        | I      | I     | I    | I                    | I                 | I        | I      | I     | I      | I                    | I                 | I        | I      | I     | I    | I                    |  |  |

TABLE 25. CONTINUED.

| SUBSYSTEM               | PARAMETER          | UH-60A                  |          |        |       |      |                      |       |          | UH-47C |       |      |                      |       |          |        |       | UH-50C |                      |       |          |        |       |      |                      | UH-16 |          |        |       |      |                      |   |   |   |   |   |   |   |
|-------------------------|--------------------|-------------------------|----------|--------|-------|------|----------------------|-------|----------|--------|-------|------|----------------------|-------|----------|--------|-------|--------|----------------------|-------|----------|--------|-------|------|----------------------|-------|----------|--------|-------|------|----------------------|---|---|---|---|---|---|---|
|                         |                    | PRE/POST<br>START       | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | START | TAKE-OFF | CRUISE | HOVER | LAND   | PRE/POST<br>SHUTDOWN | START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN |   |   |   |   |   |   |   |
| APU                     | Exhaust Temp. High | C                       | -        | -      | -     | -    | C                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | Oil Pressure Low   | C                       | -        | -      | -     | -    | C                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | Overspeed          | C                       | -        | -      | -     | -    | C                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | Underspeed         | C                       | -        | -      | -     | -    | C                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | Sequence Fail      | C                       | -        | -      | -     | -    | C                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | Fire               | C                       | -        | -      | -     | -    | C                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | Generator On       | A                       | -        | -      | -     | -    | A                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | APU On             | A                       | -        | -      | -     | -    | A                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | Tachometer         | I                       | -        | -      | -     | -    | I                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -      | -                    | -     | -        | -      | -     | -    | -                    | -     | -        | -      | -     | -    | -                    | - | - | - | - | - | - | - |
|                         | Electrical         | Generator(s) Output Low | C        | C      | C     | C    | C                    | C     | C        | C      | C     | C    | C                    | C     | C        | C      | C     | C      | C                    | C     | C        | C      | C     | C    | C                    | C     | C        | C      | C     | C    | C                    | C | C | C | C | C | C | C |
| AC Inverter Output Low  |                    |                         |          |        |       |      |                      |       |          |        |       |      |                      |       |          |        |       |        |                      |       |          |        |       |      |                      |       |          |        |       |      |                      |   |   |   |   |   |   |   |
| Converter(s) Output Low |                    | C                       | C        | C      | C     | C    | C                    |       |          |        |       |      |                      |       |          |        |       |        |                      |       |          |        |       |      |                      |       |          |        |       |      |                      |   |   |   |   |   |   |   |
| Rectifier Off           |                    |                         |          |        |       |      |                      | C     | C        | C      | C     | C    |                      |       |          |        |       |        |                      |       |          |        |       |      |                      |       |          |        |       |      |                      |   |   |   |   |   |   |   |
| Battery Low Charge      |                    | C                       | C        | C      | C     | C    | C                    |       |          |        |       |      |                      |       |          |        |       |        |                      |       |          |        |       |      |                      |       |          |        |       |      |                      |   |   |   |   |   |   |   |
| Battery Fault           |                    | C                       | C        | C      | C     | C    | C                    |       |          |        |       |      |                      |       |          |        |       |        |                      |       |          |        |       |      |                      |       |          |        |       |      |                      |   |   |   |   |   |   |   |
| AC Ess. Bus Off         | C                  | C                       | C        | C      | C     | C    |                      |       |          |        |       |      |                      |       |          |        |       |        |                      |       |          |        |       |      |                      |       |          |        |       |      |                      |   |   |   |   |   |   |   |

TABLE 25. CONTINUED.

| SUBSYSTEM           | PARAMETER                  | UH-60A   |       |          |        |       |      |          |          | OH-47C |          |        |       |      |          |          |       | OH-58C   |        |       |      |          |          |       |          | AH-1G  |       |      |          |          |   |  |  |
|---------------------|----------------------------|----------|-------|----------|--------|-------|------|----------|----------|--------|----------|--------|-------|------|----------|----------|-------|----------|--------|-------|------|----------|----------|-------|----------|--------|-------|------|----------|----------|---|--|--|
|                     |                            | PRE/POST | START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST | SHUTDOWN | START  | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST | SHUTDOWN | START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST | SHUTDOWN | START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST | SHUTDOWN |   |  |  |
| Electrical (Cont'd) | DC Ess Bus Off             | C        | C     | C        | C      | C     | C    | C        | C        | A      | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | - |  |  |
|                     | Ext. Pwr. Connected        | A        | -     | -        | -      | -     | -    | -        | -        | A      | C        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | - |  |  |
|                     | AC Loadmeter               |          |       |          |        |       |      |          |          | I      | I        | I      | I     | I    | I        | I        | I     | I        | I      | I     | I    | I        | I        | I     | I        | I      | I     | I    | I        | I        | I |  |  |
|                     | DC Loadmeter               |          |       |          |        |       |      |          |          | I      | I        | I      | I     | I    | I        | I        | I     | I        | I      | I     | I    | I        | I        | I     | I        | I      | I     | I    | I        | I        | I |  |  |
| Eng.                | Fire                       | W        | W     | W        | W      | W     | W    | W        | W        | C      | C        | C      | C     | C    | C        | C        | C     | C        | C      | C     | C    | C        | C        | C     | C        | C      | C     | C    | C        | C        | C |  |  |
| Flt. Path Stab      | Flt. Path Stab Sys. Fail   | -        | C     | C        | C      | C     | -    | -        | -        | -      | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | - |  |  |
| Stabilator          | Stabilator Auto Mode In Up | C/I      | C/I   | C/I      | C/I    | C/I   | C/I  | C/I      | C/I      | -      | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | - |  |  |
|                     | Position                   | I        | I     | I        | I      | I     | I    | I        | I        | I      | I        | I      | I     | I    | I        | I        | I     | I        | I      | I     | I    | I        | I        | I     | I        | I      | I     | I    | I        | I        | I |  |  |
| SAS                 | SAS Off                    | -        | C     | C        | C      | C     | -    | -        | -        | -      | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | - |  |  |
| Pitch Bias Actuator | Pitch Bias Failure         | C        | C     | C        | C      | C     | C    | C        | C        | C      | C        | C      | C     | C    | C        | C        | C     | C        | C      | C     | C    | C        | C        | C     | C        | C      | C     | C    | C        | C        | C |  |  |
| Gust Lock           | Not Fully Disengaged       | C        | C     | -        | -      | -     | -    | -        | -        | C      | C        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | -     | -        | -      | -     | -    | -        | -        | - |  |  |
| IFF                 | Inoperative                | C        | C     | C        | C      | C     | C    | C        | C        | C      | C        | C      | C     | C    | C        | C        | C     | C        | C      | C     | C    | C        | C        | C     | C        | C      | C     | C    | C        | C        | C |  |  |

TABLE 25. CONTINUED.

| SUBSYSTEM      | PARAMETER             | UH-60A            |          |        |       |      |                      | CH-47C            |          |        |       |      |                      | OH-58C            |          |        |       |      |                      | AH-1G             |          |        |       |      |                      |
|----------------|-----------------------|-------------------|----------|--------|-------|------|----------------------|-------------------|----------|--------|-------|------|----------------------|-------------------|----------|--------|-------|------|----------------------|-------------------|----------|--------|-------|------|----------------------|
|                |                       | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN | PRE/POST<br>START | TAKE-OFF | CRUISE | HOVER | LAND | PRE/POST<br>SHUTDOWN |
| Eng. Anti-Ice  | Anti-Ice On           | -                 | A        | A      | A     | A    | -                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |
| Pilot Heat     | Pilot Heat On         | A                 | A        | A      | A     | A    |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |
| Heater         | Heater Hot            |                   |          |        |       |      |                      | C                 | C        | C      | C     | C    | C                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |
| Cargo Hook     | Cargo Hook Open       | -                 | A        | A      | A     | A    | -                    | -                 | C        | C      | C     | C    | -                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |
|                | Hook Armed            | -                 | A        | A      | A     | A    | -                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |
| Parking Brake  | Parking Brake On      | A                 | -        | -      | -     | A    | C                    | -                 | -        | -      | -     | -    | C                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |
| Eng. Starter   | Eng. Start Valve Open | C                 | -        | -      | -     | -    | -                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |                   |          |        |       |      |                      |
| Landing Gear   | Wheel De-Phased       |                   |          |        |       |      |                      | C                 | -        | -      | -     | C    | C                    |                   |          |        |       |      |                      |                   |          |        |       |      |                      |
| Master Caution | Caution Light On      | M                 | M        | M      | M     | M    | M                    | M                 | M        | M      | M     | M    | M                    | M                 | M        | M      | M     | M    | M                    | M                 | M        | M      | M     | M    | M                    |

TABLE 26. SIGNAL SOURCE IMPROVEMENT AREAS.

1. Capacitance Probe (Fuel)

Reliability - 1100 hrs.  
Accuracy - .6% analog, .25% digital  
Improvements - Plug-in circuit boards, external test points, improved component reliability

2. Thermistors (Low Fuel)

Reliability - 1100 hrs.  
Improvements - Calculation of time remaining rather than quantity remaining

3. Variable Reluctance Sensor (XMSN Oil)

Reliability - 4000 hrs.  
Accuracy - 5%  
Improvements - Improve accuracy to 1 - 2% with metallized diaphragm with semi-conductor bridge

4. Temperature Sensor (XMSN Oil)

Reliability - Satisfactory  
Accuracy -  $+3^{\circ}\text{C}$   
Improvements -  $\pm 1.2^{\circ}\text{C}$  achievable

5. Thermistor (Engine Oil Temp)

Reliability - 2500 hrs.  
Accuracy -  $+3^{\circ}\text{C}$   
Improvements -  $\pm 1.2^{\circ}\text{C}$  achievable

6. Transducer (Engine Oil Pressure)

Reliability - 4000 hrs.  
Accuracy - 5%  
Improvements - 1 - 2% achievable via metallized diaphragm with semi-conductor bridge

TABLE 26. CONTINUED.

7. Thermocouple Harness Probe (TIT)

Reliability - Satisfactory  
 Accuracy - +5%  
 Improvements - +3% possible with multiple element probes; grounding of thermocouple elements is sometimes a problem that may be solved with closed probes

8. Tach Pulse Sensor (NG, NR)

Reliability - 5000 hrs.  
 Accuracy - .5% of full scale  
 Improvements - .1 - .2% achievable; need for improving critical gap problems

9. Shaft Twist Sensor (Torque)

Reliability - Satisfactory  
 Accuracy - 1% of full scale  
 Improvements - Use of shaft twist with measurement of phase of pulses

10. IR Sensor (Fire)

Reliability - Satisfactory  
 Improvements - Improvements in circuitry and false warnings by ambient IR contamination

11. Chip Detection (Engine, XMSN)

Reliability - 3000 hrs.  
 Improvements - Ability to distinguish "fuzz" from "chip"; fuzz burnoff; possible combination of magnetic with electrical grid as filtering system; measurement of debris for maintenance purposes

12. Mechanical Limit Switch (Oil Filter Pressure Differential)

Reliability - Satisfactory  
 Improvements - Possible combination of reading with manifold pressure reading for diagnostic purposes

TABLE 26. CONTINUED.

13. DC Power Monitor

- Improvements - Develop an improved method of monitoring status of DC bus. Present method provides only go/no-go information, and there is need for a more sophisticated system capable of warning of degraded operation.

14. Fuel Flow Measurement

- Reliability - Mass flow type sensor is fair. Volumetric type is excellent.
- Accuracy - 1 - 2% of 800 lb/hr
- Improvements - Mass flow contamination is a problem; volumetric type requires temperature compensation, and use of microprocessor is recommended.

15. Aircraft Weight Measurement

- Improvements - Investigate locating weight sensors on landing gear and other locations to facilitate aircraft weight and CG measurement.

LEGEND: TABLES 27-30.

| Column         | Code       | Explanation  |
|----------------|------------|--|
| Dimensions     | #          | Quantitative dimension only displayed                            |
|                | Q          | Qualitative dimension only displayed                             |
|                | B          | Both qualitative and quantitative dimensions displayed           |
| System         | Fuel       | Related fuel system parameters also displayed                    |
|                | Engine     | Related engine system parameters also displayed                  |
|                | XMSN       | Related XMSN system parameters also displayed                    |
|                | Hydraulic  | Related hydraulic system parameters also displayed               |
|                | Electrical | Related electrical system parameters also displayed              |
| Auto Response  | APU        | Related APU system parameters also displayed                     |
|                |            |  |
| Auto Response  | D          | Auto response is desirable and should be considered              |
|                | N          | No desirability of auto response beyond that currently available |
| Auto Feedback  | D          | Feedback indicating auto response performed is desirable         |
|                | N          | Feedback not desirable   |
| Auto Recording | D          | Auto recording of parameter variables is desirable               |
|                | N          | Auto recording of parameter variables is not desirable           |

LEGEND. CONTINUED.

| Column        | Code           | Explanation   |
|---------------|----------------|---|
| Urgency       | 1              | Safety Critical   |
|               | 2              | Mission Essential   |
|               | 3              | Maintenance required/advisory   |
|               | -              | Optionally accessed, no urgency assigned                                |
| Priority      | 1,2,...,N<br>* | Ranked priority of message<br>Optionally accessed, no priority assigned |
| Display Logic | W              | Warning Message, Displayed by Exception                                 |
|               | C              | Caution Message, Displayed by Exception                                 |
|               | P              | Precaution Message, Displayed By Exception                              |
|               | M              | Manually accessed information   |

TABLE 27. UH-60A DISPLAY LOGIC.

TABLE 1

| Parameter/Message         | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|---------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| Low Rotor RPM             | 1       | 1        | W             | B         | Engine | N             |               | D              |
| Low Rotor RPM (Rotor RPM) | 1       | 7        | C             | B         | Engine | N             |               | D              |
| #1 Engine Out             | -       | *        | M             | B         | Engine | N             |               |                |
| #2 Engine Out             | 1       | 2        | W             | Q         | Engine | N             |               | D              |
| #1 Engine Fire            | 1       | 3        | W             | Q         | Engine | N             |               | D              |
| #2 Engine Fire            | 1       | 4        | W             | Q         | Engine | N             |               | D              |
| APU Fire                  | 1       | 5        | W             | Q         | Engine | N             |               | D              |
| Stabilator Inoperative    | 1       | 6        | W             | Q         | APU    | N             |               | D              |
| #1 Overtorque             | 1       | 8        | C             | Q         | --     | N             |               | D              |
| #1 Overtorque             | 1       | 9        | C             | B         | Ungine | N             |               | D              |
| #2 Overtorque             | 1       | 61       | P             | B         | Engine | N             |               | D              |
| (#1 Torque)               | 1       | 10       | C             | B         | Engine | N             |               | D              |
| (#2 Torque)               | 1       | 62       | P             | B         | Engine | N             |               | D              |
| Main Rotor Overspeed      | -       | *        | M             | B         | Engine | N             |               | N              |
| Main Rotor Overspeed      | -       | *        | M             | B         | Engine | N             |               | N              |
| Main Rotor Overspeed      | 1       | 11       | C             | B         | Engine | N             |               | D              |
| Main Rotor Overspeed      | 1       | 63       | P             | B         | Engine | N             |               | D              |

TABLE 1  
Page 2

TABLE 27. CONTINUED.

| Parameter/Message          | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|----------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| IFF Inoperative            | 1       | 12       | C             | Q         | --     | N             |               | D              |
| #1 Np High/Low             | 1       | 13       | C             | B         | Engine | N             |               | D              |
| #1 Np High/Low             | 1       | 64       | P             | B         | Engine | N             |               | D              |
| (#1 Np)                    | -       | *        | M             | B         | Engine | N             |               | D              |
| #2 Np High/Low             | 1       | 14       | C             | B         | Engine | N             |               | D              |
| #2 Np High/Low             | 1       | 65       | P             | B         | Engine | N             |               | D              |
| (#2 Np)                    | -       | *        | M             | B         | Engine | N             |               | D              |
| #1 Fuel Pressure Low       | 1       | 15       | C             | #         | Fuel   | D             |               | D              |
| (#1 Fuel Pressure)         | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #2 Fuel Pressure Low       | 1       | 16       | C             | #         | Fuel   | D             |               | D              |
| (#2 Fuel Pressure)         | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #1 Ng High                 | 1       | 17       | C             | B         | Engine | N             |               | D              |
| #1 Ng High                 | 1       | 66       | P             | B         | Engine | N             |               | D              |
| (#1 Ng)                    | -       | *        | M             | B         | Engine | N             |               | N              |
| #2 Ng High                 | 1       | 18       | C             | B         | Engine | N             |               | D              |
| #2 Ng High                 | 1       | 67       | P             | B         | Engine | N             |               | D              |
| (#2 Ng)                    | -       | *        | M             | B         | Engine | N             |               | N              |
| XMSN 011 Pressure Low/High | 1       | 19       | C             | B         | XMSN   | N             |               | D              |
| XMSN 011 Pressure Low/High | 1       | 68       | P             | B         | XMSN   | N             |               | D              |
| (XMSN 011 Pressure)        | -       | *        | M             | B         | XMSN   | N             |               | N              |
| XMSN 011 Temperature High  | 1       | 20       | C             | B         | XMSN   | N             |               | D              |
| XMSN 011 Temperature High  | 1       | 69       | P             | B         | XMSN   | N             |               | D              |
| (XMSN 011 Temperature)     | -       | *        | M             | B         | XMSN   | N             |               | N              |

TABLE 27. CONTINUED.

| Parameter/Message               | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|---------------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| Chip Main XMSN                  | 1       | 21       | C             | Q         | XMSN   | N             |               | D              |
| Chip Intermediate XMSN          | 1       | 22       | C             | Q         | XMSN   | N             |               | D              |
| Chip Tail XMSN                  | 1       | 23       | C             | Q         | XMSN   | N             |               | D              |
| #1 Engine Chip                  | 1       | 24       | C             | Q         | Engine | N             |               | D              |
| #2 Engine Chip                  | 1       | 25       | C             | Q         | Engine | N             |               | D              |
| #1 Engine 011 Pressure Low/High | 1       | 26       | C             | B         | Engine | N             |               | D              |
| #1 Engine 011 Pressure Low/High | 1       | 70       | P             | B         | Engine | N             |               | D              |
| (#1 Engine 011 Pressure)        | -       | *        | M             | B         | Engine | N             |               | N              |
| #2 Engine 011 Pressure Low/High | 1       | 27       | C             | B         | Engine | N             |               | D              |
| #2 Engine 011 Pressure Low/High | 1       | 71       | P             | B         | Engine | N             |               | D              |
| (#2 Engine 011 Pressure)        | -       | *        | M             | B         | Engine | N             |               | N              |
| #1 Engine 011 Temperature High  | 1       | 28       | C             | B         | Engine | N             |               | D              |
| #1 Engine 011 Temperature High  | 1       | 72       | P             | B         | Engine | N             |               | D              |
| (#1 Engine 011 Temperature)     | -       | *        | M             | B         | Engine | N             |               | N              |
| #2 Engine 011 Temperature High  | 1       | 29       | C             | B         | Engine | N             |               | D              |
| #2 Engine 011 Temperature High  | 1       | 73       | P             | B         | Engine | N             |               | D              |
| (#2 Engine 011 Temperature)     | -       | *        | M             | B         | Engine | N             |               | N              |
| #1 TGT High                     | 1       | 30       | C             | B         | Engine | N             |               | D              |
| #1 TGT High                     | 1       | 74       | P             | B         | Engine | N             |               | D              |
| (#1 TGT)                        | -       | *        | M             | B         | Engine | N             |               | N              |

TABLE 27. CONTINUED.

| Parameter/Message              | Urgency | Priority | Display Logic | Dimension | System    | Auto Response | Auto Feedback | Auto Recording |
|--------------------------------|---------|----------|---------------|-----------|-----------|---------------|---------------|----------------|
| #2 TGT High                    | 1       | 31       | C             | B         | Engine    | N             |               | D              |
| #2 TGT High                    | 1       | 75       | P             | B         | Engine    | N             |               | D              |
| (#2 TGT)                       | -       | *        | M             | B         | Engine    | N             |               | d              |
| #1 Primary Servo Pressure Low  | 1       | 32       | C             | Q         | -         | N             |               | D              |
| (#1 Primary Servo Pressure)    | -       | *        | M             | #         | Hydraulic | N             |               | N              |
| #2 Primary Servo Pressure Low  | 1       | 33       | C             | Q         | -         | N             |               | D              |
| (#2 Primary Servo Pressure)    | -       | *        | M             | #         | Hydraulic | N             |               | N              |
| #1 Primary Servo Jam           | 1       | 34       | C             | Q         | -         | N             |               | D              |
| #2 Primary Servo Jam           | 1       | 35       | C             | Q         | -         | N             |               | D              |
| Tail Rotor Servo Jam           | 1       | 36       | C             | Q         | -         | N             |               | D              |
| #1 Hydraulic Pump Pressure Low | 1       | 37       | C             | Q         | -         | N             |               | D              |
| (#1 Hydraulic Pump Pressure)   | -       | *        | M             | #         | Hydraulic | N             |               | N              |
| #2 Hydraulic Pump Pressure Low | 1       | 38       | C             | Q         | -         | N             |               | D              |
| (#2 Hydraulic Pump Pressure)   | -       | *        | M             | #         | Hydraulic | N             |               | N              |
| #1 Fuel Low                    | 1       | 39       | C             | #         | Fuel      | N             |               | D              |
| #1 Fuel Low                    | 1       | 76       | P             | #         | Fuel      | N             |               | D              |
| (#1 Fuel (Time to go))         | -       | *        | M             | #         | Fuel      | N             |               | N              |
| (#1 Fuel (lbs remaining))      | -       | *        | M             | #         | Fuel      | N             |               | N              |

TABLE 27. CONTINUED.

| Parameter/Message           | Urgency | Priority | Display Logic | Dimension | System     | Auto Response | Auto Feedback | Auto Recording |
|-----------------------------|---------|----------|---------------|-----------|------------|---------------|---------------|----------------|
| #2 Fuel Low                 | 1       | 40       | C             | #         | Fuel       | N             |               | D              |
| #2 Fuel Low                 | 1       | 77       | P             | #         | Fuel       | N             |               | D              |
| (#2 Fuel (Time to go)       | -       | *        | M             | #         | Fuel       | N             |               | N              |
| (#2 Fuel (Lbs Remaining)    | -       | *        | M             | #         | Fuel       | N             |               | N              |
| (Total Fuel (time to go)    | -       | *        | M             | #         | Fuel       | N             |               | N              |
| (Total Fuel (Lbs Remaining) | -       | *        | M             | #         | Fuel       | N             |               | N              |
| SAS Off                     | 1       | 41       | C             | Q         | --         | N             |               | D              |
| Flt Path Stab Sys Inop      | 1       | 42       | C             | Q         | --         | N             |               | D              |
| DC Ess Bus Off              | 2       | 43       | C             | Q         | --         | N             |               | D              |
| (DC Ess Bus Load)           | -       | *        | M             | Q         | Electrical | N             |               | N              |
| AC Ess Bus Off              | 2       | 44       | C             | Q         | --         | N             |               | D              |
| (AC Ess Bus Load)           | -       | *        | M             | Q         | Electrical | N             |               | N              |
| Pitch Bias Failure          | 2       | 45       | C             | Q         | --         | N             |               | D              |
| #1 Generator Output Low     | 2       | 46       | C             | Q         | --         | N             |               | D              |
| (#1 Generator Output)       | -       | *        | M             | #         | Electrical | N             |               | N              |
| #2 Generator Output Low     | 2       | 47       | C             | Q         | --         | N             |               | D              |
| (#2 Generator Output)       | -       | *        | M             | #         | Electrical | N             |               | N              |
| #1 Converter Output Low     | 2       | 48       | C             | Q         | --         | N             |               | D              |
| (#1 Converter Output)       | -       | *        | M             | #         | Electrical | N             |               | N              |

TABLE 27. CONTINUED.

| Parameter/Message                             | Urgency | Priority | Display Logic | Dimension | System     | Auto Response | Auto Feedback | Auto Recording |
|---|---------|----------|---------------|-----------|------------|---------------|---------------|----------------|
| #2 Converter Output Low (#2 Converter Output) | 2       | 49       | C             | Q         | -          | N             |               | D              |
| Boost Servo Jam                               | -       | *        | M             | #         | Electrical | N             |               | N              |
| #1 Oil Filter Bypass                          | 2       | 50       | C             | Q         | -          | N             |               | D              |
| #2 Oil Filter Bypass                          | 2       | 51       | C             | Q         | -          | N             |               | D              |
| XMSN Oil Bypass                               | 2       | 52       | C             | Q         | -          | N             |               | D              |
| #1 Fuel Filter Bypass                         | 2       | 53       | C             | Q         | -          | N             |               | D              |
| #2 Fuel Filter Bypass                         | 2       | 54       | C             | Q         | -          | N             |               | D              |
| Battery Fault                                 | 2       | 55       | C             | Q         | -          | N             |               | D              |
| Battery Low Charge                            | 3       | 56       | C             | Q         | -          | N             |               | D              |
| APU Fail                                      | 3       | 57       | C             | Q         | -          | N             |               | D              |
| Gust Lock Not Disengaged                      | 3       | 58       | C             | Q         | APU        | N             |               | D              |
| External Power Connected                      | 3       | 59       | C             | Q         | -          | N             |               | D              |
| Backup Pump On                                | 3       | 60       | C             | Q         | -          | N             |               | D              |
| Cargo Hook Open                               | 3       | 78       | A             | Q         | -          | N             |               | N              |
| Cargo Hook Armed                              | 3       | 79       | A             | Q         | -          | N             |               | N              |
| Prime Boost Pump On                           | 3       | 80       | A             | Q         | -          | N             |               | N              |
| APU On  | 3       | 81       | A             | Q         | -          | N             |               | N              |
|   | 3       | 82       | A             | Q         | -          | N             |               | N              |

TABLE 27. CONTINUED.

| Parameter/Message       | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|-------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| APU Generator On        | 3       | 83       | A             | Q         | -      | N             |               | N              |
| Pitot Heat On           | 3       | 84       | A             | Q         | -      | N             |               | N              |
| Engine Start Valve Open | 3       | 85       | A             | Q         | -      | N             |               | N              |
| Parking Brake On        | 3       | 86       | A             | Q         | -      | N             |               | N              |
| #1 Engine Anti-Ice On   | 3       | 87       | A             | Q         | -      | N             |               | N              |
| #2 Engine Anti-Ice On   | 3       | 88       | A             | Q         | -      | N             |               | N              |
| Landing Light On        | 3       | 89       | A             | Q         | -      | N             |               | N              |
| Fuel Precaution Set At  | 3       | 90       | A             | #         | -      | N             |               | N              |

TABLE 28. CH-47C DISPLAY LOGIC.

| Parameter/Message         | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|---------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| Low Rotor RPM             | 1       | 1        | W             | B         | Engine | N             |               | D              |
| Low Rotor RPM (Rotor RPM) | 1       | 7        | C             | B         | Engine | N             |               | D              |
|                           | -       | *        | M             | B         | Engine | N             |               | N              |
| #1 Engine Out             | 1       | 2        | W             | Q         | Engine | N             |               | D              |
| #2 Engine Out             | 1       | 3        | W             | Q         | Engine | N             |               | D              |
| #1 Engine Fire            | 1       | 4        | W             | Q         | Engine | N             |               | D              |
| #2 Engine Fire            | 1       | 5        | W             | Q         | Engine | N             |               | D              |
| APU Fire                  | 1       | 6        | W             | Q         | APU    | N             |               | D              |
| #1 Overtorque             | 1       | 8        | C             | B         | Engine | N             |               | D              |
| #1 Overtorque             | 1       | 64       | P             | B         | Engine | N             |               | D              |
| #2 Overtorque             | 1       | 9        | C             | B         | Engine | N             |               | D              |
| #2 Overtorque             | 1       | 65       | P             | B         | Engine | N             |               | D              |
| (#1 Torque)               | -       | *        | M             | B         | Engine | N             |               | N              |
| (#2 Torque)               | -       | *        | M             | B         | Engine | N             |               | N              |
| Rotor Overspeed           | 1       | 10       | C             | B         | Engine | N             |               | D              |
| Rotor Overspeed           | 1       | 66       | P             | B         | Engine | N             |               | D              |
| IFF Inoperative           | 1       | 11       | C             | Q         | --     | N             |               | D              |

TABLE 28. CONTINUED.

| Parameter/Message                                    | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|--|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| #1 Main Fuel Pressure Low<br>(#1 Main Fuel Pressure) | 1       | 12       | C             | #         | Fuel   | D             | D             | D              |
|  | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #2 Main Fuel Pressure Low<br>(#2 Main Fuel Pressure) | 1       | 13       | C             | #         | Fuel   | D             | D             | D              |
|  | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #1 Fwd Aux Pressure Low<br>(#1 Fwd Aux Pressure)     | 1       | 14       | C             | #         | Fuel   | D             | D             | D              |
|  | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #2 Fwd Aux Pressure Low<br>(#2 Fwd Aux Pressure)     | 1       | 15       | C             | #         | Fuel   | D             | D             | D              |
|  | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #1 Aft Aux Pressure Low<br>(#1 Aft Aux Pressure)     | 1       | 16       | C             | #         | Fuel   | D             | D             | D              |
|  | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #2 Aft Aux Pressure Low<br>(#2 Aft Aux Pressure)     | 1       | 17       | C             | #         | Fuel   | D             | D             | D              |
|  | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #1 Cross Feed Fuel Valve                             | 1       | 18       | C             | #         | --     | N             |               | D              |
| #2 Cross Feed Fuel Valve                             | 1       | 19       | C             | #         | --     | N             |               | D              |
| #1 Engine Fuel Valve                                 | 1       | 20       | C             | #         | --     | N             |               | D              |
| #2 Engine Fuel Valve                                 | 1       | 21       | C             | #         | --     | N             |               | D              |
| #1 Ng High   | 1       | 22       | C             | B         | Engine | N             |               | D              |
| #1 Ng High   | 1       | 67       | P             | B         | Engine | N             |               | D              |
| (#1 Ng)  | -       | *        | M             | B         | Engine | N             |               | N              |

TABLE 28. CONTINUED.

| Parameter/Message                | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|----------------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| #2 Ng High                       | 1       | 23       | C             | B         | Engine | N             |               | D              |
| #2 Ng High                       | 1       | 68       | P             | B         | Engine | N             |               | D              |
| (#2 Ng)                          | -       | *        | M             | B         | Engine | N             |               | N              |
| Fwd XMSN Oil Pressure Low/High   | 1       | 24       | C             | B         | XMSN   | N             |               | D              |
| Fwd XMSN Oil Pressure Low/High   | 1       | 69       | P             | B         | XMSN   | N             |               | D              |
| (Fwd XMSN Oil Pressure)          | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Aft XMSN Oil Pressure Low/High   | 1       | 25       | C             | B         | XMSN   | N             |               | D              |
| Aft XMSN Oil Pressure Low/High   | 1       | 70       | P             | B         | XMSN   | N             |               | D              |
| (Aft XMSN Oil Pressure)          | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Mix XMSN Oil Pressure Low/High   | 1       | 26       | C             | B         | XMSN   | N             |               | D              |
| Mix XMSN Oil Pressure Low/High   | 1       | 71       | P             | B         | XMSN   | N             |               | D              |
| (Mix XMSN Oil Pressure)          | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Left XMSN Oil Pressure Low/High  | 1       | 27       | C             | B         | XMSN   | N             |               | D              |
| Left XMSN Oil Pressure Low/High  | 1       | 72       | P             | B         | XMSN   | N             |               | D              |
| (Left XMSN Oil Pressure)         | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Right XMSN Oil Pressure Low/High | 1       | 28       | C             | B         | XMSN   | N             |               | D              |
| Right XMSN Oil Pressure Low/High | 1       | 73       | P             | B         | XMSN   | N             |               | D              |
| (Right XMSN Oil Pressure)        | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Fwd XMSN Oil Temperature High    | 1       | 29       | C             | B         | XMSN   | N             |               | D              |
| Fwd XMSN Oil Temperature High    | 1       | 74       | P             | B         | XMSN   | N             |               | D              |
| (Fwd XMSN Oil Temperature)       | -       | *        | M             | B         | XMSN   | N             |               | N              |

TABLE 28. CONTINUED.

| Parameter/Message               | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|---------------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| Aft XMSN Oil Temperature High   | 1       | 30       | C             | B         | XMSN   | N             |               | D              |
| Aft XMSN Oil Temperature High   | 1       | 75       | P             | B         | XMSN   | N             |               | D              |
| (Aft XMSN Oil Temperature)      | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Mix XMSN Oil Temperature High   | 1       | 31       | C             | B         | XMSN   | N             |               | D              |
| Mix XMSN Oil Temperature High   | 1       | 76       | P             | B         | XMSN   | N             |               | D              |
| (Mix XMSN Oil Temperature)      | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Left XMSN Oil Temperature High  | 1       | 32       | C             | B         | XMSN   | N             |               | D              |
| Left XMSN Oil Temperature High  | 1       | 77       | P             | B         | XMSN   | N             |               | D              |
| (Left XMSN Oil Temperature)     | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Right XMSN Oil Temperature High | 1       | 33       | C             | B         | XMSN   | N             |               | D              |
| Right XMSN Oil Temperature High | 1       | 78       | P             | B         | XMSN   | N             |               | D              |
| (Right XMSN Oil Temperature)    | -       | *        | M             | B         | XMSN   | N             |               | N              |
| XMSN Chip                       | 1       | 34       | C             | Q         | XMSN   | N             |               | D              |
| #1 Engine Chip                  | 1       | 35       | C             | Q         | Engine | N             |               | D              |
| #2 Engine Chip                  | 1       | 36       | C             | Q         | Engine | N             |               | D              |
| #1 Engine Oil Pressure Low/High | 1       | 37       | C             | B         | Engine | N             |               | D              |
| #1 Engine Oil Pressure Low/High | 1       | 79       | P             | B         | Engine | N             |               | D              |
| (#1 Engine Oil Pressure)        | -       | *        | M             | B         | Engine | N             |               | N              |
| #2 Engine Oil Pressure Low/High | 1       | 38       | C             | B         | Engine | N             |               | D              |
| #2 Engine Oil Pressure Low/High | 1       | 80       | P             | B         | Engine | N             |               | D              |
| (#2 Engine Oil Pressure)        | -       | *        | M             | B         | Engine | N             |               | N              |

TABLE 28. CONTINUED.

| Parameter/Message              | Urgency | Priority | Display Logic | Dimension | System    | Auto Response | Auto Feedback | Auto Recording |
|--------------------------------|---------|----------|---------------|-----------|-----------|---------------|---------------|----------------|
| #1 Engine Oil Temperature High | 1       | 39       | C             | B         | Engine    | N             |               | D              |
| #1 Engine Oil Temperature High | 1       | 81       | P             | B         | Engine    | N             |               | D              |
| (#1 Engine Oil Temperature)    | -       | *        | M             | B         | Engine    | N             |               | N              |
| #2 Engine Oil Temperature High | 1       | 40       | C             | B         | Engine    | N             |               | D              |
| #2 Engine Oil Temperature High | 1       | 82       | P             | B         | Engine    | N             |               | D              |
| (#2 Engine Oil Temperature)    | -       | *        | M             | B         | Engine    | N             |               | N              |
| #1 Engine Oil Quantity Low     | 1       | 41       | C             | Q         | Engine    | N             |               | D              |
| #2 Engine Oil Quantity Low     | 1       | 42       | C             | Q         | Engine    | N             |               | D              |
| #1 EGT High                    | 1       | 43       | C             | B         | Engine    | N             |               | D              |
| #1 EGT High                    | 1       | 83       | P             | B         | Engine    | N             |               | D              |
| (#1 EGT)                       | -       | *        | M             | B         | Engine    | N             |               | N              |
| #2 EGT High                    | 1       | 44       | C             | B         | Engine    | N             |               | D              |
| #2 EGT High                    | 1       | 84       | P             | B         | Engine    | N             |               | D              |
| (#2 EGT)                       | -       | *        | M             | B         | Engine    | N             |               | N              |
| #1 Hydraulic Pump Pressure Low | 1       | 45       | C             | Q         | --        | N             |               | D              |
| (#1 Hydraulic Pump Pressure)   | -       | *        | M             | #         | Hydraulic | N             |               | N              |
| #2 Hydraulic Pump Pressure Low | 1       | 46       | C             | Q         | --        | N             |               | D              |
| (#2 Hydraulic Pump Pressure)   | -       | *        | M             | #         | Hydraulic | N             |               | N              |
| #1 Main Fuel Low               | 1       | 47       | C             | #         | Fuel      | D             | D             | D              |
| #1 Main Fuel Low               | 1       | 85       | P             | #         | Fuel      | N             |               | D              |

TABLE 28. CONTINUED.

| Parameter/Message                | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|----------------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| (#1 Main Fuel (Time to go)       | -       | *        | M             | #         | Fuel   | N             |               | N              |
| (#1 Main Fuel (Lbs remaining)    | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #2 Main Fuel Low                 | 1       | 48       | C             | #         | Fuel   | D             | D             | D              |
| #2 Main Fuel Low                 | 1       | 86       | P             | #         | Fuel   | N             |               | D              |
| (#2 Main Fuel (Time to go)       | -       | *        | M             | #         | Fuel   | N             |               | N              |
| (#2 Main Fuel (Lbs remaining)    | -       | *        | M             | #         | Fuel   | N             |               | N              |
| #1 Fwd Aux Fuel Low              | 1       | 49       | C             | #         | Fuel   | D             | D             | D              |
| #1 Fwd Aux Fuel Low              | 1       | 87       | P             | #         | Fuel   | N             |               | N              |
| (#1 Fwd Aux Fuel (Time to go)    | -       | *        | M             | #         | Fuel   | N             |               |                |
| (#1 Fwd Aux Fuel (Lbs remaining) | -       | *        | M             | #         | Fuel   | N             |               |                |
| #2 Fwd Aux Fuel Low              | 1       | 50       | C             | #         | Fuel   | D             | D             | D              |
| #2 Fwd Aux Fuel Low              | 1       | 88       | P             | #         | Fuel   | N             |               | N              |
| (#2 Fwd Aux Fuel (Time to go)    | -       | *        | M             | #         | Fuel   | N             |               |                |
| (#2 Fwd Aux Fuel (Lbs remaining) | -       | *        | M             | #         | Fuel   | N             |               |                |
| #1 Aft Aux Fuel Low              | 1       | 51       | C             | #         | Fuel   | D             | D             | D              |
| #1 Aft Aux Fuel Low              | 1       | 89       | P             | #         | Fuel   | N             |               | N              |
| (#1 Aft Aux Fuel (Time to go)    | -       | *        | M             | #         | Fuel   | N             |               |                |
| (#1 Aft Aux Fuel (Lbs remaining) | -       | *        | M             | #         | Fuel   | N             |               |                |
| #2 Aft Aux Fuel Low              | 1       | 52       | C             | #         | Fuel   | D             | D             | D              |
| #2 Aft Aux Fuel Low              | 1       | 90       | P             | #         | Fuel   | N             |               | N              |
| (#2 Aft Aux Fuel (Time to go)    | -       | *        | M             | #         | Fuel   | N             |               |                |
| (#2 Aft Aux Fuel (Lbs remaining) | -       | *        | M             | #         | Fuel   | N             |               |                |

TABLE 28. CONTINUED.

| Parameter/Message              | Urgency | Priority | Display Logic | Dimension | System     | Auto Response | Auto Feedback | Auto Recording |
|--------------------------------|---------|----------|---------------|-----------|------------|---------------|---------------|----------------|
| (Total Fuel (Time to go)       | -       | *        | M             | #         | Fuel       | N             |               | N              |
| (Total Fuel (Lbs remaining)    | -       | *        | M             | #         | Fuel       | N             |               | N              |
| SAS Off                        | 1       | 53       | C             | Q         | --         | N             |               | D              |
| #1 Generator Output Low        | 2       | 54       | C             | --        | --         | N             |               | D              |
| (#1 Generator Output)          | -       | *        | M             | #         | Electrical | N             |               | N              |
| #2 Generator Output Low        | 2       | 55       | C             | Q         | --         | N             |               | D              |
| (#2 Generator Output)          | -       | *        | M             | #         | Electrical | N             |               | N              |
| #1 Rectifier Output Low        | 2       | 56       | C             | Q         | --         | N             |               | D              |
| (#1 Rectifier Output)          | -       | *        | M             | #         | Electrical | N             |               | N              |
| #2 Rectifier Output Low        | 2       | 57       | C             | Q         | --         | N             |               | D              |
| (#2 Rectifier Output)          | -       | *        | M             | #         | Electrical | N             |               | N              |
| Boost Servo Pressure Low       | 2       | 58       | C             | Q         | --         | N             |               | D              |
| APU Fail                       | 2       | 60       | C             | Q         | APU        | N             |               | D              |
| Utility Hydraulic Pressure Low | 2       | 59       | C             | Q         | --         | N             |               | D              |
| External Power Connected       | 3       | 61       | C             | Q         | --         | N             |               | N              |
| Wheel De-Phased                | 3       | 62       | C             | Q         | --         | N             |               | D              |
| Heater Hot                     | 3       | 63       | C             | Q         | --         | N             |               | D              |

TABLE 28. CONTINUED.

| Parameter/Message                        | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|--|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| #1 N <sub>1</sub> Control Loop Energized | -       | 91       | A             | Q         | --     | N             |               | D              |
| #2 N <sub>1</sub> Control Loop Energized | -       | 92       | A             | Q         | --     | N             |               | D              |
| Cargo Hook Open                          | -       | 93       | A             | Q         | --     | N             |               | N              |
| Parking Brake On                         | -       | 94       | A             | Q         | --     | N             |               | N              |
| Fuel Precaution Set At                   | 3       | 95       | A             | #         | --     | N             |               | N              |

TABLE 29. AH-1G DISPLAY LOGIC.

| Parameter/Message                 | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|-----------------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| Low Rotor RPM                     | 1       | 1        | W             | B         | Engine | N             |               | D              |
| Low Rotor RPM (Rotor RPM)         | 1       | 4        | C             | B         | Engine | N             |               | D              |
|                                   | -       | *        | M             | B         | Engine | N             |               | N              |
| Engine Out                        | 1       | 2        | W             | Q         | Engine | N             |               | D              |
| Engine Fire                       | 1       | 3        | W             | Q         | Engine | N             |               | D              |
| Overtorque                        | 1       | 5        | C             | B         | Engine | N             |               | D              |
| Overtorque (Torque)               | 1       | 31       | P             | B         | Engine | N             |               | D              |
|                                   | -       | *        | M             | B         | Engine | N             |               | N              |
| Rotor Overspeed                   | 1       | 6        | C             | B         | Engine | N             |               | D              |
| Rotor Overspeed                   | 1       | 32       | P             | B         | Engine | N             |               | D              |
| IFF Inoperative                   | 1       | 7        | C             | Q         | --     | N             |               | D              |
| Mp High/Low                       | 1       | 8        | C             | B         | Engine | N             |               | D              |
| Mp High/Low (Mp)                  | 1       | 33       | P             | B         | Engine | N             |               | D              |
|                                   | -       | *        | M             | B         | Engine | N             |               | N              |
| Fuel Pressure Low (Fuel Pressure) | 1       | 9        | C             | #         | Fuel   | D             | D             | D              |
|                                   | -       | *        | M             | #         | Fuel   | N             |               | N              |
| Mg High                           | 1       | 10       | C             | B         | Engine | N             |               | D              |
| Mg High (Mg)                      | 1       | 34       | P             | B         | Engine | N             |               | D              |
|                                   | -       | *        | M             | B         | Engine | N             |               | N              |

TABLE 29. CONTINUED.

| Parameter/Message            | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|------------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| XMSN 011 Pressure Low/High   | 1       | 11       | C             | B         | XMSN   | N             |               | D              |
| XMSN 011 Pressure Low/High   | 1       | 35       | P             | B         | XMSN   | N             |               | D              |
| (XMSN 011 Pressure)          | -       | *        | M             | B         | XMSN   | N             |               | N              |
| XMSN 011 Temperature High    | 1       | 12       | C             | B         | XMSN   | N             |               | D              |
| XMSN 011 Temperature High    | 1       | 36       | P             | B         | XMSN   | N             |               | D              |
| (XMSN 011 Temperature)       | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Chip Main XMSN               | 1       | 13       | C             | Q         | XMSN   | N             |               | D              |
| Chip Intermediate XMSN       | 1       | 14       | C             | Q         | XMSN   | N             |               | D              |
| Chip Tail XMSN               | 1       | 15       | C             | Q         | XMSN   | N             |               | D              |
| Engine Chip                  | 1       | 16       | C             | Q         | Engine | N             |               | D              |
| Engine 011 Pressure Low/High | 1       | 17       | C             | B         | Engine | N             |               | D              |
| Engine 011 Pressure Low/High | 1       | 37       | P             | B         | Engine | N             |               | D              |
| (Engine 011 Pressure)        | -       | *        | M             | B         | Engine | N             |               | N              |
| Engine 011 Temperature High  | 1       | 18       | C             | B         | Engine | N             |               | D              |
| Engine 011 Temperature High  | 1       | 38       | P             | B         | Engine | N             |               | D              |
| (Engine 011 Temperature)     | -       | *        | M             | B         | Engine | N             |               | N              |
| EGT High                     | 1       | 19       | C             | B         | Engine | N             |               | D              |
| EGT High                     | 1       | 39       | P             | B         | Engine | N             |               | D              |
| (EGT)                        | -       | *        | M             | B         | Engine | N             |               | N              |

TABLE 29. CONTINUED.

| Parameter/Message                                    | Urgency | Priority | Display Logic | Dimension | System     | Auto Response | Auto Feedback | Auto Recording |
|--|---------|----------|---------------|-----------|------------|---------------|---------------|----------------|
| #1 Hydraulic Pressure Low<br>(#1 Hydraulic Pressure) | 1       | 20       | C             | Q         | --         | N             |               | D              |
|  | -       | *        | M             | #         | Hydraulic  | N             |               | N              |
| #2 Hydraulic Pressure Low<br>(#2 Hydraulic Pressure) | 1       | 21       | C             | Q         | --         | N             |               | D              |
|  | -       | *        | M             | #         | Hydraulic  | N             |               | N              |
| Fuel Low   | 1       | 22       | C             | #         | Fuel       | N             |               | D              |
| Fuel Low   | 1       | 40       | P             | #         | Fuel       | N             |               | D              |
| (Fuel (Time to go)                                   | -       | *        | M             | #         | Fuel       | N             |               | N              |
| (Fuel (Lbs remaining)                                | -       | *        | M             | #         | Fuel       | N             |               | N              |
| DC Generator Output Low<br>(DC Generator Output)     | 2       | 23       | C             | Q         | --         | N             |               | D              |
|  | -       | *        | M             | #         | Electrical | N             |               | N              |
| AC Inverter Output Low<br>(AC Inverter Output)       | 2       | 24       | C             | Q         | --         | N             |               | D              |
|  | -       | *        | M             | #         | Electrical | N             |               | N              |
| Oil Filter Bypass                                    | 2       | 25       | C             | Q         | --         | N             |               | D              |
| XMSN Oil Bypass                                      | 2       | 26       | C             | Q         | --         | N             |               | D              |
| Fuel Filter Bypass                                   | 2       | 27       | C             | Q         | --         | N             |               | D              |
| Fwd Fuel Boost Pressure Low                          | 2       | 28       | C             | Q         | --         | N             |               | D              |
| Aft Fuel Boost Pressure Low                          | 2       | 29       | C             | Q         | --         | N             |               | D              |
| External Power Connected                             | 3       | 30       | C             | Q         | --         | N             |               | N              |

TABLE 30. OH-58C DISPLAY LOGIC.

| Parameter/Message                 | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|-----------------------------------|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| Low Rotor RPM                     | 1       | 1        | W             | B         | Engine | N             |               | D              |
| Low Rotor RPM (Rotor RPM)         | 1       | 4        | C             | B         | Engine | N             |               | D              |
|                                   | -       | *        | M             | B         | Engine | N             |               | N              |
| Engine Out                        | 1       | 2        | W             | Q         | Engine | N             |               | D              |
| Engine Fire                       | 1       | 3        | W             | Q         | Engine | N             |               | D              |
| Overtorque                        | 1       | 5        | C             | B         | Engine | N             |               | D              |
| Overtorque (Torque)               | 1       | 27       | P             | B         | Engine | N             |               | D              |
|                                   | -       | *        | M             | B         | Engine | N             |               | N              |
| Rotor Overspeed                   | 1       | 6        | C             | B         | Engine | N             |               | D              |
| Rotor Overspeed                   | 1       | 28       | P             | B         | Engine | N             |               | D              |
| IFF Inoperative                   | 1       | 7        | C             | Q         | --     | N             |               | D              |
| Np Low                            | 1       | 8        | C             | B         | Engine | N             |               | D              |
| Np Low (Np)                       | 1       | 29       | P             | B         | Engine | N             |               | D              |
|                                   | -       | *        | M             | B         | Engine | N             |               | N              |
| Fuel Pressure Low (Fuel Pressure) | 1       | 9        | C             | #         | Fuel   | D             | D             | D              |
|                                   | -       | *        | M             | #         | Fuel   | N             |               | N              |
| Mg High                           | 1       | 10       | C             | B         | Engine | N             |               | D              |
| Mg High (Mg)                      | 1       | 30       | P             | B         | Engine | N             |               | D              |
|                                   | -       | *        | M             | B         | Engine | N             |               | N              |

TABLE 30. CONTINUED.

| Parameter/Message  | Urgency | Priority | Display Logic | Dimension | System | Auto Response | Auto Feedback | Auto Recording |
|--|---------|----------|---------------|-----------|--------|---------------|---------------|----------------|
| XMSN 011 Pressure Low/High                               | 1       | 11       | C             | B         | XMSN   | N             |               | D              |
| XMSN 011 Pressure Low/High (XMSN 011 Pressure)           | 1       | 31       | P             | B         | XMSN   | N             |               | D              |
|  | -       | *        | M             | B         | XMSN   | N             |               | N              |
| XMSN 011 Temperature High                                | 1       | 12       | C             | B         | XMSN   | N             |               | D              |
| XMSN 011 Temperature High (XMSN 011 Temperature)         | 1       | 32       | P             | B         | XMSN   | N             |               | D              |
|  | -       | *        | M             | B         | XMSN   | N             |               | N              |
| Chip Main XMSN   | 1       | 13       | C             | Q         | XMSN   | N             |               | D              |
| Chip Intermediate XMSN                                   | 1       | 14       | C             | Q         | XMSN   | N             |               | D              |
| Chip Tail XMSN   | 1       | 15       | C             | Q         | XMSN   | N             |               | D              |
| Engine Chip  | 1       | 16       | C             | Q         | Engine | N             |               | D              |
| Engine 011 Pressure Low/High                             | 1       | 17       | C             | B         | Engine | N             |               | D              |
| Engine 011 Pressure Low/High (Engine 011 Pressure)       | 1       | 33       | P             | B         | Engine | N             |               | D              |
|  | -       | *        | M             | B         | Engine | N             |               | N              |
| Engine 011 Temperature Low/High                          | 1       | 18       | C             | B         | Engine | N             |               | D              |
| Engine 011 Temperature Low/High (Engine 011 Temperature) | 1       | 34       | P             | B         | Engine | N             |               | D              |
|  | -       | *        | M             | B         | Engine | N             |               | N              |
| TOT High   | 1       | 19       | C             | B         | Engine | N             |               | D              |
| TOT High (TOT)   | 1       | 35       | P             | B         | Engine | N             |               | D              |
|  | -       | *        | M             | B         | Engine | N             |               | N              |

TABLE 30. CONTINUED.

| Parameter/Message                           | Urgency | Priority | Display Logic | Dimension | System     | Auto Response | Auto Feedback | Auto Recording |
|---|---------|----------|---------------|-----------|------------|---------------|---------------|----------------|
| Hydraulic pressure low (Hydraulic pressure) | 1       | 20       | C             | Q         | --         | N             |               | D              |
| Fuel Low                                    | -       | *        | M             | #         | Hydraulic  | N             |               | N              |
| Fuel Low (Fuel (Time to go))                | 1       | 21       | C             | E         | Fuel       | N             |               | D              |
| Fuel (Lbs remaining)                        | 1       | 36       | P             | #         | Fuel       | N             |               | D              |
| DC Generator Output Low                     | -       | *        | M             | #         | Fuel       | N             |               | N              |
| DC Generator Output                         | -       | *        | M             | #         | Fuel       | N             |               | N              |
| AC Generator Output Low                     | 2       | 22       | C             | Q         | --         | N             |               | D              |
| AC Generator Output                         | 2       | 23       | *             | #         | Electrical | N             |               | N              |
| Oil Filter Bypass                           | 2       | 24       | C             | Q         | --         | N             |               | D              |
| Fuel Filter Bypass                          | 2       | 25       | C             | Q         | --         | N             |               | D              |
| Fuel Boost Pressure Low                     | 2       | 26       | C             | Q         | --         | N             |               | D              |
| Fuel Precaution Set At                      | 3       | 37       | A             | #         | --         | N             |               | N              |

TABLE 31. UH-60A RELATED SYSTEM PARAMETERS.

| System | Parameters   |
|--------|--|
| Fuel   | Time Remaining (#1, #2, Total)<br>Lbs Remaining (#1, #2, Total)<br>Pressure (#1, #2)                         |
| Engine | Torque (#1, #2)<br>NR<br>NP (#1, #2)<br>NG (#1, #2)<br>TGT (#1, #2)<br>Oil Temp (#1, #2)<br>Oil PSI (#1, #2) |
| XMSN   | Pressure<br>Temperature  |

TABLE 31. CONTINUED.

| Fuel       | Parameters  |
|------------|---|
| Hydraulics | Flt Ctrl Pressure (#1, #2)<br>Primary Servo Pressure (#1, #2)<br>T/R Servo Pressure (#1, #2)  |
| Electrical | DC Gen Output (#1, #2)<br>AC Conv Output (#1, #2)<br>AC Ess Bus Status<br>DC Ess Bus Status<br>Pri Bus Status (#1, #2)<br>Monitor Bus Status (#1, #2) |
| APU        | NP<br>EGT<br>Oil PSI<br>Accumulator PSI<br>Generator Output   |

**TABLE 32. CH-47C RELATED SYSTEM PARAMETERS.**

| System     | Parameters   |
|------------|--|
| Fuel       | Time Remaining (Main, Fwd Aux, Aft Aux: #1, #2, Total)<br>Lbs Remaining (Main, Fwd Aux, Aft Aux: #1, #2, Total)<br>Pressure (Main, Fwd Aux, Aft Aux: #1, #2) |
| Engine     | Torque (#1, #2)<br>NR<br>NP (#1, #2)<br>NG (#1, #2)<br>Egt (#1, #2)<br>Oil Temperature (#1, #2)<br>Oil PSI (#1, #2)<br>Oil Quantity (#1, #2)                 |
| XMSN       | Pressure (Fwd, Aft, Mix, Left, Right)<br>Temperature (Fwd, Aft, Mix, Left, Right)  |
| Hydraulics | Flt Ctrol PSI (#1, #2)<br>Util Hyd PSI (#1, #2)<br>Boost Servo PSI   |
| Electrical | DC Gen Output (#1, #2)<br>AC Rect Output (#1, #2)  |
| APU        | NP<br>EGT<br>Oil PSI<br>Accumulator PSI<br>Gen Output Status   |

**TABLE 33. AG-1G RELATED SYSTEM PARAMETERS.**

| System     | Parameters  |
|------------|---|
| Fuel       | Time Remaining<br>Lbs Remaining<br>Pressure                   |
| Engine     | Torque<br>NR<br>NP<br>NG<br>EGT<br>Oil PSI<br>Oil Temperature |
| XMSN       | Pressure<br>Temperature                                       |
| Hydraulics | PSI (#1, #2)  |
| Electrical | DC Gen Output<br>AC Inv Output                                |

TABLE 34. OH-58C RELATED SYSTEM PARAMETERS.

| System     | Parameters  |
|------------|---|
| Fuel       | Time Remaining<br>Lbs Remaining<br>Pressure                   |
| Engine     | Torque<br>NR<br>NP<br>NG<br>TOT<br>Oil PSI<br>Oil Temperature |
| XMSN       | Pressure<br>Temperature                                       |
| Hydraulics | Pressure  |
| Electrical | DC Gen Output<br>AC Inv Output                                |

TABLE 35. UH-60A PRIORITIZATION.

| WARNING MESSAGES |                |         |
|------------------|----------------|---------|
| Priority         | Message        | Trigger |
| 1                | Low Rotor RPM  | NR <90% |
| 2                | #1 Engine Out  | NG <55% |
| 3                | #2 Engine Out  | NG <55% |
| 4                | #1 Engine Fire | --      |
| 5                | #2 Engine Fire | --      |
| 6                | APU Fire       | --      |

| CAUTION MESSAGES |                         |                     |
|------------------|-------------------------|---------------------|
| Priority         | Message                 | Trigger             |
| 7                | Low Rotor RPM           | NR <95%             |
| 8                | Stabilator Inop         | --                  |
| 9                | #1 Overtorque           | TRQ >114%           |
| 10               | #2 Overtorque           | TRQ >114%           |
| 11               | Main Rotor overspeed    | NR >125%            |
| 12               | IFF Inoperative         | --                  |
| 13               | #1 NP High/Low          | NP >110%, <90%      |
| 14               | #2 NP High/Low          | NP >110%, <90%      |
| 15               | #1 Fuel Pressure Low    | Press <8.5 PSI      |
| 16               | #2 Fuel Pressure Low    | Press <8.5 PSI      |
| 17               | #1 NG High              | NG >104%            |
| 18               | #2 NG High              | NG >104%            |
| 19               | XMSN Oil Press Low/High | Press <25, >130 PSI |
| 20               | XMSN Oil Temp High      | Temp >140°C         |
| 21               | Chip Main XMSN          | --                  |
| 22               | Chip Intermediate XMSN  | --                  |
| 23               | Chip Tail XMSN          | --                  |
| 24               | #1 Engine Chip          | --                  |
| 25               | #2 Engine Chip          | --                  |

TABLE 35. CONTINUED.

| Priority | Message                   | Trigger             |
|----------|---------------------------|---------------------|
| 26       | #1 Eng Oil Press Low/High | Press <25, >100 PSI |
| 27       | #2 Eng Oil Press Low/High | Press <25, >100 PSI |
| 28       | #1 Eng Oil Temp High      | Temp >150°C         |
| 29       | #2 Eng Oil Temp High      | Temp >150°C         |
| 30       | #1 TGT High               | TGT >850°C          |
| 31       | #2 TGT High               | TGT >850°C          |
| 32       | #1 PRI Servo Press Low    | Press <2000 PSI     |
| 33       | #2 PRI Servo Press Low    | Press <2000 PSI     |
| 34       | #1 PRI Servo Jam          | --                  |
| 35       | #2 PRI Servo Jam          | --                  |
| 36       | Tail Rotor Servo Jam      | --                  |
| 37       | #1 HYD Pump Press Low     | Press <2000 PSI     |
| 38       | #2 HYD Pump Press Low     | Press <2000 PSI     |
| 39       | #1 Fuel Low               | < 30 Mins           |
| 40       | #2 Fuel Low               | < 30 Mins           |
| 41       | SAS Off                   | --                  |
| 42       | Flt Path Stab Sys Inop    | --                  |
| 43       | DC Ess Bus Off            | --                  |
| 44       | AC Ess Bus Off            | --                  |
| 45       | Pitch Bias Failure        | --                  |
| 46       | #1 Gen Output Low         | --                  |
| 47       | #2 Gen Output Low         | --                  |
| 48       | #1 Conv Output Low        | --                  |
| 49       | #2 Conv Output Low        | --                  |
| 50       | Boost Servo Jam           | --                  |
| 51       | #1 Oil Filter Bypass      | --                  |
| 52       | #2 Oil Filter Bypass      | --                  |
| 53       | XMSN Oil Bypass           | --                  |
| 54       | #1 Fuel Filter Bypass     | --                  |
| 55       | #2 Fuel Filter Bypass     | --                  |
| 56       | Battery Fault             | --                  |
| 57       | Battery Low Charge        | --                  |
| 58       | APU Fail                  | --                  |
| 59       | Gust Lock Not Disengaged  | --                  |
| 60       | External Pwr Connected    | --                  |

TABLE 35. CONTINUED.

## PRECAUTION MESSAGES

| Priority | Message                   | Trigger            |
|----------|---------------------------|--------------------|
| 61       | #1 Overtorque             | TRQ >104%          |
| 62       | #2 Overtorque             | TRQ >104%          |
| 63       | Main Rotor Overspeed      | NR >103%           |
| 64       | #1 NP High/Low            | NP >103%, <95%     |
| 65       | #2 NP High/Low            | NP >103%, <95%     |
| 66       | #1 NG High                | NG >102%           |
| 67       | #2 NG High                | NG >102%           |
| 68       | XMSN Oil Press Low/High   | Press <35, >65 PSI |
| 69       | XMSN Oil Temp High        | Temp >120°C        |
| 70       | #1 Eng Oil Press Low/High | Press <45, >80 PSI |
| 71       | #2 Eng Oil Press Low/High | Press <45, >80 PSI |
| 72       | #1 Eng Oil Temp High      | Temp >135°C        |
| 73       | #2 Eng Oil Temp High      | Temp >135°C        |
| 74       | #1 TGT High               | TGT >775°C         |
| 75       | #2 TGT High               | TGT >775°C         |
| 76       | #1 Fuel Low               | Settable           |
| 77       | #2 Fuel Low               | Settable           |

## ADVISORY MESSAGES

| Priority | Message                 | Trigger  |
|----------|-------------------------|----------|
| 78       | Backup Pump On          | --       |
| 79       | Cargo Hook Open         | --       |
| 80       | Cargo Hook Armed        | --       |
| 81       | Prime Boost Pump On     | --       |
| 82       | APU On                  | --       |
| 83       | APU Gen On              | --       |
| 84       | Pitot Heat On           | --       |
| 85       | Engine Start Valve Open | --       |
| 86       | Parking Brake On        | --       |
| 87       | #1 Eng Anti-Ice On      | --       |
| 88       | #2 Eng Anti-Ice On      | --       |
| 89       | Landing Light On        | --       |
| 90       | Fuel Precaution Set At  | Settable |

TABLE 36. CH-47C PRIORITIZATION.

WARNING MESSAGES

| Priority | Message        | Trigger |
|----------|----------------|---------|
| 1        | Low Rotor RPM  | NR <90% |
| 2        | #1 Engine Out  | NG <55% |
| 3        | #2 Engine Out  | NG <55% |
| 4        | #1 Engine Fire | -       |
| 5        | #2 Engine Fire | -       |
| 6        | APU Fire       | -       |

CAUTION MESSAGES

| Priority | Message                     | Trigger            |
|----------|-----------------------------|--------------------|
| 7        | Low Rotor RPM               | NR <95%            |
| 8        | #1 Overtorque               | TRQ >114%          |
| 9        | #2 Overtorque               | TRQ >114%          |
| 10       | Main Rotor Overspeed        | NR >125%           |
| 11       | IFF Inoperative             | --                 |
| 12       | #1 Main Fuel Press Low      | Press <10 PSI      |
| 13       | #2 Main Fuel Press Low      | Press <10 PSI      |
| 14       | #1 Fwd Aux Fuel Press Low   | Press <10 PSI      |
| 15       | #2 Fwd Aux Fuel Press Low   | Press <10 PSI      |
| 16       | #1 Aft Aux Fuel Press Low   | Press <10 PSI      |
| 17       | #2 Aft Aux Fuel Press Low   | Press <10 PSI      |
| 18       | #1 Xfeed Fuel Valve         | --                 |
| 19       | #2 Xfeed Fuel Valve         | --                 |
| 20       | #1 Engine Fuel Valve        | --                 |
| 21       | #2 Engine Fuel Valve        | --                 |
| 22       | #1 NG High                  | NG >104%           |
| 23       | #2 NG High                  | NG >104%           |
| 24       | Fwd XMSN Oil Press Low/High | Press <20, >90 PSI |
| 25       | Aft XMSN Oil Press Low/High | Press <20, >90 PSI |

TABLE 36. CONTINUED.

## CAUTION MESSAGES, cont.

| Priority | Message                       | Trigger             |
|----------|-------------------------------|---------------------|
| 26       | Mix XMSN Oil Press Low/High   | Press <20, >90 PSI  |
| 27       | Left XMSN Oil Press Low/High  | Press <20, >90 PSI  |
| 28       | Right XMSN Oil Press Low/High | Press <20, >90 PSI  |
| 29       | Fwd XMSN Oil Temp High        | Temp >140°C         |
| 30       | Aft XMSN Oil Temp High        | Temp >140°C         |
| 31       | Mix XMSN Oil Temp High        | Temp >140°C         |
| 32       | Left XMSN Oil Temp High       | Temp >140°C         |
| 33       | Right XMSN Oil Temp High      | Temp >140°C         |
| 34       | XMSN Chip                     | --                  |
| 35       | #1 Engine Chip                | --                  |
| 36       | #2 Engine Chip                | --                  |
| 37       | #1 Engine Oil Press Low/High  | Press <40, >110 PSI |
| 38       | #2 Engine Oil Press Low/High  | Press <40, >110 PSI |
| 39       | #1 Engine Oil Temp High       | Temp >138°C         |
| 40       | #2 Engine Oil Temp High       | Temp >138°C         |
| 41       | #1 Engine Oil Quantity Low    | Qty <2 qts          |
| 42       | #2 Engine Oil Quantity Low    | Qty <2 qts          |
| 43       | #1 EGT High                   | EGT >620°C          |
| 44       | #2 EGT High                   | EGT >620°C          |
| 45       | #1 HYD Pump Press Low         | Press <2500 PSI     |
| 46       | #2 HYD Pump Press Low         | Press <2500 PSI     |
| 47       | #1 Main Fuel Low              | <30 Mins            |
| 48       | #2 Main Fuel Low              | <30 Mins            |
| 49       | #1 Fwd Aux Fuel Low           | <30 Mins            |
| 50       | #2 Fwd Aux Fuel Low           | <30 Mins            |
| 51       | #1 Aft Aux Fuel Low           | <30 Mins            |
| 52       | #2 Aft Aux Fuel Low           | <30 Mins            |
| 53       | SAS Off                       | --                  |
| 54       | #1 Gen Output Low             | --                  |
| 55       | #2 Gen Output Low             | --                  |
| 56       | #1 Rect Output Low            | --                  |
| 57       | #2 Rect Output Low            | --                  |
| 58       | Boost Servo Press Low         | --                  |
| 59       | Utility Hyd. Press Low        | --                  |
| 60       | APU Fail                      | --                  |

TABLE 36. CONTINUED.

## CAUTION MESSAGES, cont.

| Priority | Message                | Trigger |
|----------|------------------------|---------|
| 61       | External Pwr Connected | --      |
| 62       | Wheel De-Phased        | --      |
| 63       | Heater Hot             | --      |

## PRECAUTION MESSAGES

| Priority | Message                       | Trigger            |
|----------|-------------------------------|--------------------|
| 64       | #1 Overtorque                 | TRQ >104%          |
| 65       | #2 Overtorque                 | TRQ >104%          |
| 66       | Main Rotor Overspeed          | NR >103%           |
| 67       | #1 NG High                    | NG >102%           |
| 68       | #2 NG High                    | NG >102%           |
| 69       | Fwd XMSN Oil Press Low/High   | Press <30, >80 PSI |
| 70       | Aft XMSN Oil Press Low/High   | Press <30, >80 PSI |
| 71       | Mix XMSN Oil Press Low/High   | Press <30, >80 PSI |
| 72       | Left XMSN Oil Press Low/High  | Press <30, >80 PSI |
| 73       | Right XMSN Oil Press Low/High | Press <30, >80 PSI |
| 74       | Fwd XMSN Oil Temp High        | Temp >130°C        |
| 75       | Aft XMSN Oil Temp High        | Temp >130°C        |
| 76       | Mix XMSN Oil Temp High        | Temp >130°C        |
| 77       | Left XMSN Oil Temp High       | Temp >130°C        |
| 78       | Right XMSN Oil Temp High      | Temp >130°C        |
| 79       | #1 Engine Oil Press Low/High  | Press <50, >90 PSI |
| 80       | #2 Engine Oil Press Low/High  | Press <50, >90 PSI |
| 81       | #1 Engine Oil Temp High       | Temp >130°C        |
| 82       | #2 Engine Oil Temp High       | Temp >130°C        |
| 83       | #1 EGT High                   | EGT >570°C         |
| 84       | #2 EGT High                   | EGT >570°C         |
| 85       | #1 Main Fuel Low              | Settable           |
| 86       | #2 Main Fuel Low              | Settable           |
| 87       | #1 Fwd Aux Fuel Low           | Settable           |
| 88       | #2 Fwd Aux Fuel Low           | Settable           |
| 89       | #1 Aft Aux Fuel Low           | Settable           |
| 90       | #2 Aft Aux Fuel Low           | Settable           |

TABLE 36. CONTINUED.

| ADVISORY MESSAGES |                           |          |
|-------------------|---------------------------|----------|
| Priority          | Message                   | Trigger  |
| 91                | #1 M1 CTRL Loop Energized | --       |
| 92                | #2 M1 CTRL Loop Energized | --       |
| 93                | Cargo Hook Open           | --       |
| 94                | Parking Brake On          | --       |
| 95                | Fuel Precaution Set At    | Settable |

TABLE 37. AH-1G PRIORITIZATION.

| WARNING MESSAGES |               |         |
|------------------|---------------|---------|
| Priority         | Message       | Trigger |
| 1                | Low Rotor RPM | NR <90% |
| 2                | Engine Out    | NG <55% |
| 3                | Engine Fire   | --      |

| CAUTION MESSAGES |                           |                     |
|------------------|---------------------------|---------------------|
| Priority         | Message                   | Trigger             |
| 4                | Low Rotor RPM             | NR <95%             |
| 5                | Overtorque                | TRQ >114%           |
| 6                | Main Rotor Overspeed      | NR >125%            |
| 7                | IFF Inoperative           | --                  |
| 8                | NP High/Low               | NP >110%, <90%      |
| 9                | Fuel Pressure Low         | Press <5 PSI        |
| 10               | NG High                   | NG >104%            |
| 11               | XMSN Oil Press Low/High   | Press <30, >70 PSI  |
| 12               | XMSN Oil Temp High        | Temp >110°C         |
| 13               | Chip Main XMSN            | --                  |
| 14               | Chip Intermediate XMSN    | --                  |
| 15               | Chip Tail XMSN            | --                  |
| 16               | Engine Chip               | --                  |
| 17               | Engine Oil Press Low/High | Press <25, >110 PSI |
| 18               | Engine Oil Temp High      | Temp >100°C         |
| 19               | EGT High                  | EGT >625°C          |
| 20               | #1 HYD Press Low          | --                  |
| 21               | #2 HYD Press Low          | --                  |
| 22               | Fuel Low                  | < 30 Mins           |
| 23               | DC Gen Output Low         | --                  |
| 24               | AC Inv Output Low         | --                  |
| 25               | Oil Filter Bypass         | --                  |

TABLE 37. CONTINUED.

| Priority | Message                  | Trigger |
|----------|--------------------------|---------|
| 26       | XMSN Oil Bypass          | --      |
| 27       | Fuel Filter Bypass       | --      |
| 28       | Fwd Fuel Boost Press Low | --      |
| 29       | Aft Fuel Boost Press Low | --      |
| 30       | External Pwr Connected   | --      |

## PRECAUTION MESSAGES

| Priority | Message                   | Trigger               |
|----------|---------------------------|-----------------------|
| 31       | Overtorque                | TRQ > 104%            |
| 32       | Main Rotor Overspeed      | NR > 103%             |
| 33       | NP High/Low               | NP > 103%, < 95%      |
| 34       | NG High                   | NG > 102%             |
| 35       | XMSN Oil Press Low/High   | Press < 40, > 60 PSI  |
| 36       | XMSN Oil Temp High        | Temp > 105°C          |
| 37       | Engine Oil Press Low/High | Press < 80, > 100 PSI |
| 38       | Engine Oil Temp High      | Temp > 93°C           |
| 39       | EGT High                  | EGT > 610°C           |
| 40       | Fuel Low                  | Settable              |

## ADVISORY MESSAGES

| Priority | Message                | Trigger  |
|----------|------------------------|----------|
| 41       | Fuel Precaution Set At | Settable |

TABLE 38. OH-58C PRIORITIZATION.

| WARNING MESSAGES |               |         |
|------------------|---------------|---------|
| Priority         | Message       | Trigger |
| 1                | Low Rotor RPM | NR <90% |
| 2                | Engine Out    | NG <55% |
| 3                | Engine Fire   | --      |

| CAUTION MESSAGES |                             |                     |
|------------------|-----------------------------|---------------------|
| Priority         | Message                     | Trigger             |
| 4                | Low Rotor RPM               | NR <95%             |
| 5                | Overtorque                  | TRQ >114%           |
| 6                | Rotor Overspeed             | NR >110%            |
| 7                | IFF Inoperative             | --                  |
| 8                | NP Low/High                 | NP <95%, >105%      |
| 9                | Fuel Pressure Low           | TBD                 |
| 10               | NG High                     | NG >105%            |
| 11               | XMSN Oil Press Low/High     | Press <30, >70 PSI  |
| 12               | XMSN Oil Temperature High   | Temp >110°C         |
| 13               | Chip Main XMSN              | --                  |
| 14               | Chip Intermediate XMSN      | --                  |
| 15               | Chip Tail XMSN              | --                  |
| 16               | Engine Chip                 | --                  |
| 17               | Engine Oil Press Low/High   | Press <50, >130 PSI |
| 18               | Engine Oil Temperature High | Temp >107°C         |
| 19               | TOT High                    | TOT >810°C          |
| 20               | Hydraulic Pressure Low      | --                  |
| 21               | Fuel Low                    | < 30 Mins           |
| 22               | DC Generator Output Low     | --                  |
| 23               | AC Inverter Output Low      | --                  |
| 24               | Oil Filter Bypass           | --                  |
| 25               | Fuel Filter Bypass          | --                  |
| 26               | Fuel Boost Pressure Low     | --                  |

TABLE 38. CONTINUED.

| PRECAUTION MESSAGES |                              |                      |
|---------------------|------------------------------|----------------------|
| Priority            | Message                      | Trigger              |
| 17                  | Overtorque                   | TRQ >104%            |
| 28                  | Rotor Overspeed              | NR >103%             |
| 29                  | NP Low/High                  | NP <98%, >102%       |
| 30                  | NG High                      | NG >102%             |
| 31                  | XMSN Oil Pressure Low/High   | Press <40, >60 PSI   |
| 32                  | XMSN Temperature High        | Temp >105°C          |
| 33                  | Engine Oil Pressure Low/High | Press <110, >120 PSI |
| 34                  | Engine Oil Temperature High  | Temp >100°C          |
| 35                  | TOT High                     | TOT >738°C           |
| 36                  | Fuel Low                     | Settable             |

| ADVISORY MESSAGES |                        |          |
|-------------------|------------------------|----------|
| Priority          | Message                | Trigger  |
| 37                | Fuel Precaution Set At | Settable |

TABLE 39. RELATED PARAMETER GROUPS.

| <u>Group</u> | <u>Parameters</u>  |
|--------------|--|
| 1            | Engine Torque (Q) No. 1 & No. 2<br>Rotor Speed (NR)<br>Power Turbine Speed (NP) No. 1 & No. 2<br>Gas Generator Speed (NG) No. 1 & No. 2<br>Gas Turbine Temperature (TGT) No. 1 & No. 2<br>Engine Oil Pressure (PO) No. 1 & No. 2<br>Engine Oil Temperature (TO) No. 1 & No. 2<br>Engine Fire No. 1 & No. 2<br>Engine Chip No. 1 & No. 2<br>Oil Filter Bypass No. 1 & No. 2 |
| 2            | Fuel Pressure No. 1 & No. 2<br>Fuel Low No. 1 & No. 2<br>Total Fuel<br>Fuel Filter Bypass No. 1 & No. 2  |
| 3            | Transmission Oil Pressure<br>Transmission Oil Temperature<br>Transmission Oil Bypass<br>Chip, Main Transmission<br>Chip, Intermediate Transmission<br>Chip, Tail Transmission  |
| 4            | Hydraulic Pump Pressure No. 1 & No. 2<br>Primary Servo Pressure No. 1 & No. 2<br>Tail Rotor Servo Pressure<br>Boost Servo Pressure<br>Pitch Bias Failure   |

TABLE 39. CONTINUED.

| <u>Group</u> | <u>Parameters</u>   |
|--------------|---|
| 5            | Generator Output No. 1 & No. 2<br>Converter Output No. 1 & No. 2<br>DC Essential Bus ON/OFF<br>AC Essential Bus ON/OFF<br>Battery Fault<br>Battery Low Charge |
| 6            | APU Power Turbine Speed<br>APU Gas Temperature<br>APU Oil Pressure<br>Accumulator Pressure<br>APU Generator Output<br>APU Fail<br>APU Fire                    |
| 7            | Stabilator Auto Mode Inoperative<br>Flight Path Stabilization System Inoperative<br>SAS Off   |
| 8            | IFF Inoperative   |

TABLE 40. PROPERTIES OF DATA TRANSMISSION CABLES.

|                            | <u>Fiber Optics</u> | <u>Coax</u> | <u>Twisted Pair</u> |
|----------------------------|---------------------|-------------|---------------------|
| Low Cost                   | X                   |             | X                   |
| Temperature to 300°C       | X                   | X           | X                   |
| Vibration Tolerant         | X                   | X           | X                   |
| Low Cross Talk             | X                   | X           |                     |
| No Cross Talk              | X                   |             |                     |
| EMI Noise Immunity         | X                   |             |                     |
| Total Electrical Isolation | X                   |             |                     |
| No Spark/Fire Hazards      | X                   |             |                     |
| No Short-Circuit Loading   | X                   |             |                     |
| No Ringing/Echoes          | X                   |             |                     |
| EMP Immunity               | X                   |             |                     |
| Temperature to 1000°C      | X                   |             |                     |
| Weight Savings             | X                   |             |                     |
| Decreased Size             | X                   |             |                     |
| Bandwidth Capability       |                     |             |                     |
| (300 meters)               | 200 MHz             | 20 MHz      | 1 MHz               |

TABLE 41. SSM WORKLOAD REDUCTION FEATURES.

|                          | VISUAL SEARCH REDUCED | VIGILANCE ENHANCED | IDENTIFICATION ENHANCED | CLASSIFICATION ENHANCED | IRRELEVANT FEATURES REDUCED | MEMORY LOAD REDUCED | COMPUTATION REDUCED | ATTENSITY ENHANCED | DECISION-MAKING REDUCED | RESPONSE SELECTION ENHANCED |
|--------------------------|-----------------------|--------------------|-------------------------|-------------------------|-----------------------------|---------------------|---------------------|--------------------|-------------------------|-----------------------------|
| CWP DISPLAY              | X                     | X                  | X                       | X                       | X                           | X                   |                     |                    | X                       | X                           |
| PRECAUTION INDICATION    | X                     | X                  |                         | X                       | X                           | X                   |                     |                    | X                       | X                           |
| DISPLAY BY EXCEPTION     | X                     | X                  |                         | X                       | X                           | X                   |                     |                    | X                       | X                           |
| POWER MANAGEMENT DISPLAY | X                     | X                  | X                       |                         | X                           | X                   |                     |                    |                         | X                           |
| PRIORITIZATION           |                       |                    |                         | X                       | X                           | X                   |                     |                    | X                       | X                           |
| DISPLAY FORMATS          |                       |                    |                         | X                       | X                           | X                   |                     | X                  |                         |                             |
| PERIPHERAL FUNCTIONS     |                       |                    |                         |                         |                             | X                   | X                   |                    | X                       | X                           |

TABLE 42. SSM DELTA ESTIMATES: AIRCRAFT WEIGHT

| AIRCRAFT | SOA   | NT   | LT   |
|----------|-------|------|------|
| UH60-A   | + 60  | + 15 | + 15 |
| CH47-C   | + 30  | -25  | -30  |
| AH1-G    | + 100 | + 60 | + 60 |
| CH58-C   | + 105 | + 60 | + 60 |

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SOA: state-of-the-art (current) design; NT: near-term design;  
 LT: long-term design. Consult text for qualification of these  
 estimates (Task IV).

TABLE 43. UH-60A LIFE CYCLE COST ESTIMATES.

| VERSION     | FLEET LOC DELTA | PER AIRCRAFT LOC DELTA |
|-------------|-----------------|------------------------|
| NT (5 YRS)  | \$12,000,000    | \$11,000               |
| LT (10 YRS) | \$22,000,000    | \$25,000               |

(1979 CONSTANT DOLLARS)

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Consult text for qualification of these estimates.

APPENDIX B: PILOT QUESTIONNAIRE.

SUBSYSTEM STATUS MONITOR

NAME: \_\_\_\_\_

ORGANIZATION: \_\_\_\_\_

PHONE: \_\_\_\_\_

TOTAL HELICOPTER HOURS: \_\_\_\_\_

Hours UH-1 \_\_\_\_\_

Hours OH-58 \_\_\_\_\_

Hours AH-1 \_\_\_\_\_

Hours CH-47 \_\_\_\_\_

Hours UH-60A \_\_\_\_\_

NOE HOURS: \_\_\_\_\_

NIGHT HOURS: \_\_\_\_\_

CURRENT HELICOPTER ASSIGNMENT: \_\_\_\_\_

### Explanations and Directions

The purpose of this questionnaire is to survey the opinions of experienced helicopter pilots in order to determine ways of reducing crew workload during NOE Flight. The questionnaire is limited to methods of displaying and responding to subsystem status monitoring information. You are asked to consider carefully a variety of items of subsystem information, and to decide whether the information is necessary, and when and how it should be displayed so that the crew's workload may be reduced. Your careful decisions will influence the design of future subsystem monitors in helicopters.

Please consider each item of information in the light of the following decision areas:

#### I. Priorities

##### Explanation

In this section you are asked to decide whether it is necessary for you to be informed of the status of various subsystems, and to explain what makes this information necessary.

##### Directions

Mark an X in the column labeled:

Safety - If you decide that it is difficult or impossible to maintain the safety of the helicopter and its crew without this information

Mission - If you decide that it is difficult or impossible to complete a mission without this information (even though the information is not necessary for maintaining the safety of the aircraft and crew).

Maintenance - If you decide that the information is necessary to assist you in recommending maintenance items (even though the information is not necessary to maintain safety or to complete a mission)

Unnecessary - If you decide that the information is not necessary in order to maintain safety, complete a mission, or recommend maintenance.

\* Only one (1) column should be marked for each item of information considered in this section.

\*\* If you mark the UNNECESSARY column for an item, there is no need to continue to the other sections for that item.

## II. Mission Phase

### Explanation

In this section you are asked to explain when during a typical mission it is necessary for you to be informed of the status of various subsystems, and when during a typical mission the information is unnecessary.

### Directions

Mark an X in the column labeled:

TAKEOFF - if you decide the information is necessary before, during, or immediately after takeoff.

CRUISE - if you decide the information is necessary during cruise

HOVER - if you decide the information is necessary during hover

LAND - if you decide the information is necessary during landings.

SHUTDOWN- if you decide the information is necessary immediately before, during, or after shutdown

\* More than one column may be marked for each item of information considered in this section.

## III. Environment

### Explanation

In this section you are asked to explain the environmental conditions during which it is necessary for you to be informed of the status of various subsystems, and the environmental conditions during which the information is unnecessary.

### Directions

Mark an X in the column labeled:

NIGHT - if you decide the information is necessary during night flight

DAY - if you decide the information is necessary during daytime flight

VMC - if you decide the information is necessary during VMC flight

IMC - if you decide the information is necessary during the IMC flight

NOE - if you decide the information is necessary during the NOE flight

ALTITUDE- if you decide the information is necessary during flight at ALTITUDE

\* More than one column may be marked for each item of information considered in this section.

#### IV. Display

##### Explanation

In this section you are asked to decide whether it is necessary to display items of information at all times, or whether other means of display are more appropriate.

##### Directions

Mark an X in the column labeled:

- CONTINUAL - if you decide that the information must be displayed at all times
- CRITICAL ONLY - if you decide that the information must be displayed only to announce a critical condition affecting aircraft safety or mission completion
- ACCESS ONLY - if you decide that the information must be displayed only through call-out by pilot or copilot

\* Only one (1) column should be marked for each item of information considered in this section.

#### V. Format

##### Explanation

In this section you are asked to decide upon the least amount of content required to display the necessary information for the various subsystems.

##### Directions

Mark an X in the column labeled:

- QUANTITATIVE - if you decide that numerical (scale or digital) information must be displayed
- QUALITATIVE - if you decide that numerical information is not necessary, but that both "within limits" and "beyond limits" indication is necessary.
- COMBINED - if you decide that it is necessary to display both numerical and within/beyond limits information simultaneously
- CAUTION - if you decide that it is necessary only to display "beyond limits" information.
- ADVISORY - if you decide that it is necessary only to be advised that the system is engaged or in operation.

\* Only one (1) column should be marked for each item of information in this section.

#### VI. Response

##### Explanation

In this section you are asked to decide whether it would be desirable to incorporate an automated response to the information displayed, or whether the crew must respond to the condition displayed.

##### Directions

Mark an X in the column labeled:

AUTO DESIRABLE - if you decide that it would be desirable to automate the response to the information displayed

AUTO NOT DESIRABLE - if you decide that it would not be desirable to automate the response to the information displayed, and that the crew must respond to the condition.

\* Only one (1) column should be marked for each item of information considered in this section.

\*\* If you mark AUTO NOT DESIRABLE for an item, there is no need to proceed to the next section for that item.

#### VII. Feedback

##### Explanation

In this section you are asked to consider those items which you have marked AUTO DESIRABLE, and to decide whether it is necessary to inform the crew that such an automated response has been made.

##### Directions

Mark an X in the column labeled:

Display - if you decide that it is necessary to inform the crew that the automated response has been made

Display Unnecessary - if you decide that it is not necessary to inform the crew that the automated response has been made

\* Only one (1) column should be marked for each item of information considered in this section.

#### VIII. Remarks

In this section you are asked to include any remarks, comments, suggestions, or problems that occur to you in considering each subsystem.

Especially useful would be remarks such as: "This information is unnecessary so long as (some other information) is provided."

| PARAMETER                   | PRIORITIES  | MISSION PHASE | ENVIRONMENT | DISPLAY       | FORMAT       | RE-<br>POUSE | FEED-<br>BACK       | REMARKS |
|-----------------------------|-------------|---------------|-------------|---------------|--------------|--------------|---------------------|---------|
|                             | SAFETY      |               | NIGHT       | CONTINUAL     | QUANTITATIVE |              | DISPLAY             |         |
|                             | MISSION     | TAKEOFF       | DAY         | CRITICAL ONLY | QUALITATIVE  |              | DISPLAY UNNECESSARY |         |
|                             | MAINTENANCE | CRUISE        | MOR         |               | COMBINED     |              |                     |         |
|                             | UNNECESSARY | HOVER         | INC         |               | CAUTION      |              |                     |         |
|                             |             | LAND          | WNC         |               | ADVISORY     |              |                     |         |
|                             |             | SHUTDOWN      |             |               |              |              |                     |         |
| Fuel Quantity               |             |               |             |               |              |              |                     |         |
| Fuel Low                    |             |               |             |               |              |              |                     |         |
| Fuel Pressure               |             |               |             |               |              |              |                     |         |
| Fuel Pressure Low           |             |               |             |               |              |              |                     |         |
| Fuel Filter Obstructed      |             |               |             |               |              |              |                     |         |
| Prim Boost Pump On          |             |               |             |               |              |              |                     |         |
| Fuel Boost Pressure Low     |             |               |             |               |              |              |                     |         |
| Engine Oil Temperature      |             |               |             |               |              |              |                     |         |
| Engine Oil Temperature High |             |               |             |               |              |              |                     |         |
| Engine Oil Pressure         |             |               |             |               |              |              |                     |         |
| Engine Oil Pressure Low     |             |               |             |               |              |              |                     |         |
| Engine Oil Quantity         |             |               |             |               |              |              |                     |         |
| Engine Oil Quantity Low     |             |               |             |               |              |              |                     |         |
| Oil Filter Bypass           |             |               |             |               |              |              |                     |         |
| Engine Chip                 |             |               |             |               |              |              |                     |         |

| PARAMETER                    | PRIORITIES  | MISSION PHASE | ENVIRONMENT | DISPLAY       | FORMAT       | RE-<br>PONSE       | FEED-<br>BACK       | REMARKS |
|------------------------------|-------------|---------------|-------------|---------------|--------------|--------------------|---------------------|---------|
|                              | SAFETY      | TAKEOFF       | NIGHT       | CONTINUAL     | QUANTITATIVE | AUTO DESIRABLE     | DISPLAY             |         |
|                              | MISSION     | CRUISE        | DAY         | CRITICAL ONLY | QUALITATIVE  | AUTO NOT DESIRABLE | DISPLAY UNNECESSARY |         |
|                              | MAINTENANCE | HOVER         | TIME        | ACCESS ONLY   | COMBINED     | CAUTION            |                     |         |
|                              | UNNECESSARY | LAND          | NOE         |               |              | ADVISORY           |                     |         |
|                              |             | SHUTDOWN      | ALTITUDE    |               |              |                    |                     |         |
| TIT                          |             |               |             |               |              |                    |                     |         |
| EGT                          |             |               |             |               |              |                    |                     |         |
| $P_0$                        |             |               |             |               |              |                    |                     |         |
| Inlet Air Pressure Negative  |             |               |             |               |              |                    |                     |         |
|                              |             |               |             |               |              |                    |                     |         |
| $P_9$                        |             |               |             |               |              |                    |                     |         |
| Engine Out                   |             |               |             |               |              |                    |                     |         |
| $V_1$ Control Loop Energized |             |               |             |               |              |                    |                     |         |
|                              |             |               |             |               |              |                    |                     |         |
| WASH 011 Pressure            |             |               |             |               |              |                    |                     |         |
| WASH 011 Pressure Low        |             |               |             |               |              |                    |                     |         |
| WASH 011 Temperature         |             |               |             |               |              |                    |                     |         |
| WASH 011 Temperature High    |             |               |             |               |              |                    |                     |         |
| Chip Main WASH               |             |               |             |               |              |                    |                     |         |
| Chip Int WASH                |             |               |             |               |              |                    |                     |         |
| Chip Tail WASH               |             |               |             |               |              |                    |                     |         |
| WASH 011 Bypass              |             |               |             |               |              |                    |                     |         |





| PARAMETER                  | PRIORITIES  | MISSION PHASE | ENVIRONMENT | DISPLAY       | FORMAT       | RE-<br>PONSE       | FEED-<br>BACK       | REMARKS |
|----------------------------|-------------|---------------|-------------|---------------|--------------|--------------------|---------------------|---------|
|                            | SAFETY      | TAKEOFF       | NIGHT       | CONTINUOUS    | QUANTITATIVE | AUTO DESIRABLE     | DISPLAY UNNECESSARY |         |
|                            | MISSION     | CRUISE        | DAY         | CRITICAL ONLY | QUALITATIVE  | AUTO NOT DESIRABLE |                     |         |
|                            | MAINTENANCE | HOVER         | WVC         | ACCESS ONLY   | COMBINED     | CAUTION            |                     |         |
|                            | UNNECESSARY | LAND          | INC         |               | ADVISORY     |                    |                     |         |
|                            |             | SHUTDOWN      | NOE         |               |              |                    |                     |         |
| AC Load Meter              |             |               | ALTITUDE    |               |              |                    |                     |         |
| DC Load Meter              |             |               |             |               |              |                    |                     |         |
| Engine Fire                |             |               |             |               |              |                    |                     |         |
| Flt Path Stab Sys Fail     |             |               |             |               |              |                    |                     |         |
| Stabilator Auto Mode In Op |             |               |             |               |              |                    |                     |         |
| Stabilator Position        |             |               |             |               |              |                    |                     |         |
|                            |             |               |             |               |              |                    |                     |         |
| SAS OFF                    |             |               |             |               |              |                    |                     |         |
|                            |             |               |             |               |              |                    |                     |         |
| Pitch Bias Failure         |             |               |             |               |              |                    |                     |         |
|                            |             |               |             |               |              |                    |                     |         |
| Gust Lock Not Disengaged   |             |               |             |               |              |                    |                     |         |
|                            |             |               |             |               |              |                    |                     |         |
| IFF In-Operative           |             |               |             |               |              |                    |                     |         |

| PARAMETER             | PRIORITIES  | MISSION PHASE | ENVIRONMENT | DISPLAY       | FORMAT       | RE-<br>PONSE | FEED-<br>BACK       | REMARKS |
|-----------------------|-------------|---------------|-------------|---------------|--------------|--------------|---------------------|---------|
|                       | SAFETY      |               | NIGHT       | CONTINUOUS    | QUANTITATIVE |              | DISPLAY UNNECESSARY |         |
|                       | MISSION     | TAKEOFF       | DAY         | CRITICAL ONLY | QUALITATIVE  |              |                     |         |
|                       | MAINTENANCE | CRUISE        | WMC         | ACCESS ONLY   | COMBINED     |              |                     |         |
|                       | UNNECESSARY | HOVER         | IMC         |               | CAUTION      |              |                     |         |
|                       |             | LAND          | NOE         |               | ADVISORY     |              |                     |         |
|                       |             | SHUTDOWN      | ALITUDE     |               |              |              |                     |         |
| Eng. Anti-Ice On      |             |               |             |               |              |              |                     |         |
| Pilot Heat On         |             |               |             |               |              |              |                     |         |
| Heater On             |             |               |             |               |              |              |                     |         |
| Heater Hot            |             |               |             |               |              |              |                     |         |
| Cargo Hook Open       |             |               |             |               |              |              |                     |         |
| Cargo Hook Armed      |             |               |             |               |              |              |                     |         |
| Parking Brake On      |             |               |             |               |              |              |                     |         |
| Eng. Start Valve Open |             |               |             |               |              |              |                     |         |
| Master Fuel In        |             |               |             |               |              |              |                     |         |

Additional Areas

Please answer the following questions:

Can you think of any other items of subsystem information that should be displayed in future helicopters?

Which caution/warning lights have you found illuminate most frequently?  
How frequently? During what conditions?

Are there any caution/warning lights that you have found to be unreliable?

What aspects of subsystem monitoring have you found to be most problematic, annoying, or distracting during NOE flight?

How do you feel about presenting information through voice warning systems or through beeps, tones, etc.?

What problems do you see arising with systems that require you to push buttons to obtain information about subsystems?

## APPENDIX C: CONTROL ALLOCATION CONCEPTS

"Control allocation" is a term referring to the decision-making program by which a computer monitors system operation, decides when corrective response is required, and decides whether to perform the corrective response automatically or to inform the human operator of the condition, allowing him to perform the response.

The emphasis in control allocation is upon software programming combining an open loop option (assigning control to the pilot) with closed loop features (automatic response by the machine) into a single monitoring controller, as opposed to systems which isolate machine from human control, or assign control allocation decisions to the human operator.

The application of on-board computer systems including remote sensing terminals and central processing units allows for both pre-programming of allocation and alteration of such programs. This software capability has raised intriguing and currently largely theoretical possibilities for adaptive computer-aided control. In adaptive computer-aided control, programming of control allocation is flexible and may be adapted for and by individual crew members, either by accepting of control allocation logic programmed by any given pilot (which may differ from another pilot's program), or by monitoring a pilot's responses over time and developing a model of control allocation that will duplicate the pilot's preferences for specified decisions.

An example of pilot preprogramming included in the SSM is the selection of the level at which a FUEL LOW precaution will be displayed. Each pilot may select or program a different level. The example is quite elementary, but the inclusion of an automated response as a program element would constitute an example of more extensive adaptive computer-aided control.

A program that would average pilot preferences for fuel precaution level over time rather than rely upon the last set level, as in the proposed SSM design, and respond to the average in the absence of any resetting after engine shutdown/startup would represent an example of the modelling feature of adaptive computer-aided control.

Looking toward a future in which each crew member programs the aircraft to his specific requirements, advocates of adaptive computer-aided control point to the following potential benefits:

1. Unburdening: relieves the operator of continuous monitoring and decision-making, freeing him for other command and control functions.
2. Consistency: replacing continual operator control by a decision model may significantly increase decision-making consistency, and can help insure that decisions are made optimally with respect to normative criteria.
3. Performance: may improve on secondary tasks because of unburdening.

The potential for flexible, adaptive computer-aided control leads to a variety of unanswered questions:

1. Will the concept ever achieve acceptance? Laboratory studies have shown that operators are quite willing to receive assistance from an aiding device which incorporates their own preferences, especially

once the guiding principles have been explained.

2. What forms and extent of information feedback are appropriate for operator cognizance of system operation?

3. What levels of systems are appropriate for programming? Should monitoring, display, or response be programmable, or all three?

4. How should programmable systems be protected from programming error?

5. How should programmable systems protect one human user from another?

While some form of control allocation will be an aspect of most computerized monitoring and control systems that involve human operators, the provisions for adaptive computer-aided control will require detailed study in the future. The utility of the concept of computer-aided adaptive control has not been extensively applied and proven in aircraft command and control. Both the concept and its applications require further study.

